SUPPLEMENT TO THE

APPENDIX TO THE JOURNAL OF THE SENATE

LEGISLATURE OF THE STATE OF CALIFORNIA

1957 REGULAR SESSION

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LEGISLATURE OF THE STATE OF CALIFORNIA
1957 REGULAR SESSION

REPORTS

First Part of Session—January 7th to 25th, inclusive
Second Part of Session—March 4th to June 12th, inclusive

HAROLD J. POWERS
President of the Senate

HUGH M. BURNS
President pro Tempore

J. A. BEEK
Secretary of the Senate

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PUBLIC LANDS AND RESOURCE DEVELOPMENT

SENATE INTERIM COMMITTEE ON PUBLIC LANDS

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SENATE

OF THE STATE OF CALIFORNIA

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Watershed Protection Areas

LETTER OF TRANSMITTAL

May 7, 1957

Hon. Harold J. Powers, *President*
and Members of the Senate

Gentlemen: The Senate Interim Committee on Public Lands submits herewith a report on *Public Lands and Resource Development* pursuant to the provisions of Senate Resolution No. 159 adopted June 8, 1955. This is the fourth report on public lands submitted by this committee since its first authorization in 1949.

Previous reports of this committee have discussed the extent of federal land ownership, forestry problems, and problems of state-owned lands. The emphasis of the discussion and analysis included in the current report is on the relationship of public land ownership and resource developments. This report emphasizes the need for more and immediate research and analysis of the urgent need for watershed management and greater utilization of the natural resources of this State.

Respectfully submitted,

Edwin J. Regan, Chairman
Harold T. Johnson, Vice Chairman
James E. Cunningham, Sr.
Fred S. Farr
Louis G. Sutton

2—L-610

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Illustrations: Courtesy of Department of Natural Resources

CHAPTER 1

SUMMARY AND RECOMMENDATIONS

The Senate Interim Committee on Public Lands, created by Senate Resolution No. 159 adopted June 8, 1955, was authorized "to ascertain, study, analyze all facts relating to public lands and the state, federal, and local governmental relationship involved therein," and to report thereon including recommendation for appropriate legislation. Similar authorization was included in the Senate Resolution adopted in 1949 when the committee was first created. The committee was continued in 1951, 1953, and 1955.

The first report of this committee submitted in 1951 surveyed the problems of public lands in California where approximately one-half of the total land area of approximately one hundred million acres is owned by federal, state, and local governments. The emphasis in that report was on the problem of the public lands owned by the Federal Government.

The second report of this committee submitted in 1953 traced the development of forestry in California and reviewed the results of the Forest Practice Act of 1945. This report also included an analysis of special types of forestry problems on both public and privately owned lands in this State such as service forestry, fire protection, and forest regeneration and insect control.

The third report submitted in 1955 presented the first inventory of state lands to be included in one document. This report also presented the first general analysis of state land management and the problems incident thereto.

The Senate Interim Committee on Public Lands authorized in 1955 has continued the studies inaugurated by the previous committees. The continuation of these studies has been facilitated by continuity of membership. This committee, for example, has had the same chairman since its creation in 1949 and three of the five members of this committee were members of the committee appointed in 1949. A fourth member was first appointed to this committee in 1951 and has continued as a member by subsequent appointment in 1953 and 1955. Most of the subjects considered during the 1955-56 interim, therefore, have had some previous consideration by this committee. Public land problems in California, however, are dynamic and new problems or important new aspects of standing problems constantly demand attention because of their effect on the economy of the State.

This committee held two two-day hearings on public land problems during 1956. The first hearing was in Sacramento, July 13 and 14, 1956, and the second hearing was in Los Angeles, October 25 and 26, 1956. The Sacramento hearing considered three types of public land problems (1) forestry, (2) in-lieu taxation, and (3) the necessity for returning unused state lands to the local tax rolls. Forestry problems investigated at this hearing included timber marketing, diameter cutting limits, trees and game as forest crops, forest soil, forests and water, fire protection, and range development. The in-lieu tax problems considered at this hearing included such problems relating to state beaches and parks as well as particular in-lieu tax problem of federally owned lands. The Los Angeles hearings, to a large extent, were a continuation of the investigations and problems considered at the hearings in Sacramento with emphasis on the impact and importance of these subjects to the economy of the southern part of the State.

This chapter summarizes the principal findings and recommendations resulting from these hearings and investigations.

Chapter 2 discusses current problems resulting from federal and state ownership in California. In general, the same type of public land problems are found in both types of ownership. These problems include inventory of land holdings, multiple-use principle of public land management, purposes of public land ownership, criteria for beach and park acquisitions, and the necessity for returning surplus lands to the tax rolls.

Chapter 3 discusses payments in lieu of taxes. Previous reports of this committee have discussed payments in lieu of taxes with respect to lands owned by the Federal Government. The emphasis in this report is on the necessity for such payments with respect to state beach and park lands.

Chapter 4 presents a discussion of the 1956 Fire Protection Plan. The objectives of this plan are considered in connection with the first fire protection plans developed in 1940 and 1950.

Chapter 5 reviews the results of the Forest Practice Act which has been in effective operation for the past 10 years. The need for amendments to this act are discussed in this chapter.

Chapter 6 discusses the need for the development of new forest product industries to realize full utilization of the forest resources. Methods of avoiding the limitations of past mistakes are considered in this discussion.

Chapter 7 discusses the research needed to provide a program for the neglected area of watershed man-

agement. Watershed management is now regarded as essential to the development of the dual crop of forest products and water from the forest lands in California.

FINDINGS

The principal findings of the Senate Interim Committee on Public Lands resulting from its hearings and investigations are as follows:

1. Public land problems are essentially the same for both federal and state-owned lands.
2. State agencies responsible for the administration of state-owned lands perform the same functions as the federal land management agencies in the administration of California lands owned by the Federal Government.
3. The pattern of land ownership in California with about 50 percent of the total area in public ownership has important effects on the economy of the State.
4. Timber trespass is a serious problem for both the public and private landowners and results in waste and unsound forest practices.
5. Criteria developed by the State Park Commission for acquisition and development of beach and park lands do not adequately provide for group recreation areas.
6. Legislative appropriations for specific park acquisitions are disregarded by the State Park Commission unless the proposed projects meet the standards of the established criteria.
7. The principle of payments in lieu of taxes for state-owned lands for forest and wildlife purposes is well established but does not apply to state beach and park lands.
8. The 1956 Fire Plan for the protection of wildlands and forest areas is an expansion of the first fire plans of 1940 and 1950.
9. The Forest Practice Act has been in effective operation for the past 10 years and provides the basis for maintaining a sound economy for the forest land in private ownership.
10. The lack of comprehensive information relative to wood fiber industries has retarded the development of new plant locations in California and limits provision for full utilization of the State's forest resources.
11. Watershed management is a neglected area of land management essential to the development of the dual crop of forest products and water from California's forest lands.

RECOMMENDATIONS

1. **The State Park Commission should develop criteria for the acquisition of park lands with areas to be developed for group or mass recreation purposes.**

The criteria adopted by the State Park Commission in October, 1956, as a statement of policy with respect to the acquisition and development of land for beach and park purposes, does not provide for areas suitable for group recreation. Such programs are now considered to be of primary interest and are of local communities and not of state-wide concern. The rapid growth of the State's population requires the development of such areas within reach of large centers of population. The development of such projects is believed to be in the best interests of the entire State, however, there is a serious problem of basic responsibility between the various levels of government for the development of such projects.

2. **The statutes providing for the duties and responsibilities of the State Park Commission should be amended to provide that the functions of the Commission should be performed in accordance with Legislature directives.**

The powers and duties of the State Park Commission have only been stated in very general terms by the Legislature. The commission has been given wide latitude in the performance of its assigned functions. So much so, in fact, that the commission has disregarded the express intent of the Legislature as expressed in appropriation acts for specific park land acquisitions. The commission has approved such proposed projects only when they met the provisions of their established criteria without regard to the action of the Legislature.

3. **The Forest Practice Act should be amended to provide additional enforcement provisions.**

The Forest Practice Act enacted in 1945, became effective with respect to forest district rules and regulations in 1947. The results of the administration of this act have been beneficial for the benefit of a sound economy in conservation of the forest resources and private ownership. The experience gained in the administration of this act, however, indicated a need for additional enforcement provisions.

4. **A 1956 Fire Plan for the protection of wildlands and forest areas should be implemented by provision for necessary appropriations.**

The 1956 Fire Plan developed by the State Division and Board of Forestry is an expansion of the fire protection provisions and the organized fire protection provision inaugurated by the 1940 and 1950 Fire Plans. The 1956 Fire Plan provides for additional protection facilities.

5. **Provision should be made for the coordination of policies relating to public lands and state ownership.**

State-owned lands are administered by a number of state agencies. In some respects, these agencies are

counterparts of the federal land management agencies. The purposes of public land management are approximately the same for both federal and state-owned lands. The coordination of state policies would provide an opportunity for coordination of such policies with those of the Federal Government which is particularly important to the economy of California inasmuch as publicly owned land accounts for 50 percent of the entire area of California.

6. State agencies concerned with Natural Resource Development should compile comprehensive information relative to the requirements for the development of new forest protection industries.

The lack of such information has discouraged the location of important new industries necessary to the full utilization of the State's forest resources. The proposed cellophane plant recently decided not to locate in this State because of the lack of such factual information. Such mistakes should be avoided in the future and necessary information should be provided to encourage the development of new industries in asmuch as large amounts of raw material are now going to waste.

7. There is a critical need for the development of watershed management programs in California.

The forest lands of California produce two crops (1) forest products, and (2) water. There is an urgent need for research to indicate the type of watershed information program which will conserve and improve the development of the State's water resources. The State Water Plan is based upon existing stream flow. Additional information is required for the management of the watershed areas in order to maintain and, if possible, to improve the stream flow so that the desired benefits resulting from the State Water Plan may be preserved.

8. Continued study should be made of the public land problems in California.

The studies and investigations that have been made by the Senate Interim Committee on Public Lands have indicated the need for additional research and further investigation. Some of the necessary surveys and studies have been started by the state land management agencies and other organizations as a result of the exploratory studies of this committee. Changing conditions, however, require continuing studies of the effect of public land ownership on the economy of this State.

Mt. Jacinto
State Park,
Riverside County

Winter Activity,
Calaveras Big
Trees State Park,
Calaveras County

CHAPTER 2

PUBLIC LAND PROBLEMS

The Senate Interim Committee on Public Lands has had a unique experience of investigating problems of great importance to the economy of the State which have hertofore been unexplored by any investigating committee of the Leigslature. Studies of public land problems have been conducted at the national level by Congressional committees. Studies of some of the aspects of natural resource development affecting both public and private lands such as forestry and water resources have been made by committees of the Legislature. The studies conducted by this committee, however, represent the first attempt to identify and define the State's interest in public land policy and to suggest specific areas for additional legislative inquiry and action.

One of the results of the activities of this committee has been that of a sounding board for various groups and organizations within the State that are affected by specific public land policies of all three levels of government, federal, state, and local. The need for state leadership in the determination of public land policies in specific areas has thus been effectively presented. Some of the most important problem areas are as follows:

1. Specific problem of federal ownership, acquisition, and land management.
2. State land acquisition and land management problem.
3. Multiple use of public lands.
4. Forest practices.

PUBLIC LAND INVENTORIES

One of the first problems encountered by the Senate Interim Committee on Public Lands was that of determination of the extent of the lands owned by the Federal and State Governments in California. This problem still exists as there is no exact record of the amount or value of the lands in such ownership. The 1955 report of this committee estimates that 2,268,872 acres or 2.26 percent of the total state area of 100,353,920 acres are owned by the State and that the amount of land owned by the Federal Government is 46,311,044 acres or 46.14 percent of the total.

The difficulties of determining the exact amount owned by various units of government are illustrated in the tabulation of amounts of state and federal land in the various counties as shown in the 1955 report. The total land area in Alpine County, for example, is 462,720 acres. The total area in state and federal ownership is estimated to be 463,412 acres. The error in this estimate appears to be in the amount of land in federal ownership. The largest area of federal lands in this county is the estimated 408,219 acres of national forest lands. Three bureaus of the Department of the Interior supervise an additional amount of federal land estimated to be 54,180 acres or a total of 462,399 acres in federal ownership. The State owns an estimated 1,013 acres in this county.

Another problem of public lands in California is the pattern of ownership and the checkerboard intermingling of both public and private lands. The impact of public lands on local government varies according to the percentage of total area in public ownership in the Counties Table 1 prepared from the data presented in the 1955 report shows that 18 counties have approximately half or more of their area in state and federal lands as follows:

County	*Percent state and federal*
Alpine	98
Inyo	97.47
Mono	80.94
San Bernardino	77.97
Tuolumne	75.36
Trinity	72.10
Plumas	71.75
Del Norte	70.83
Imperial	70.30
Modoc	67.73
Siskiyou	62.66
Sierra	61.58
Riverside	56.87
Lassen	50.79
Tulare	50.41

Both the State and Federal Governments own lands in all counties in the State. In general, the federal land area predominates over that of the state area. Five counties, however, have more state than federal land within their boundaries. The counties are San Joaquin, San Mateo, Santa Cruz, Solano, and Sutter. The Departments of Mental Hygiene and Public Works account for most of the State land in San Joaquin County. Beaches and Parks and highways account for the bulk of the state holdings in San Mateo County. Beaches and Parks are also important in the state area in Santa Cruz County. The Department of Fish and Game has the largest amount of state land in Solano County and the Reclamation Board has most of the state area in Sutter County.

TABLE 1

STATE AND FEDERAL LAND IN CALIFORNIA

County	State	Federal	Total governmental	Total county area	Percentage of public lands
State total	2,268,873	46,311,044	48,579,917	100,353,920	48.40
Alameda	12,465	10,957	23,422	469,120	4.99
Alpine	1,013	462,399	463,412	462,720	x
Amador	4,015	77,366	81,381	380,160	21.40
Butte	9,442	150,299	159,741	1,065,600	14.99
Calaveras	7,089	123,890	130,979	657,920	19.91
Colusa	4,267	111,770	116,037	737,920	15.77
Contra Costa	5,380	10,853	16,233	469,760	3.45
Del Norte	18,896	435,752	454,648	641,920	70.83
El Dorado	6,528	504,575	511,103	1,104,000	46.30
Fresno	35,279	1,487,968	1,523,247	3,830,400	39.77
Glenn	2,162	205,755	207,917	842,880	24.67
Humboldt	41,861	439,336	481,197	2,286,720	21.04
Imperial	143,249	1,784,097	1,927,346	2,741,760	70.30
Inyo	152,127	6,142,925	6,295,052	6,458,240	97.47
Kern	91,726	1,356,629	1,448,355	5,228,800	27.70
Kings	2,297	5,753	8,050	892,000	.90
Lake	13,836	351,915	365,751	803,840	45.50
Lassen	98,194	1,380,217	1,478,411	2,910,720	50.79
Los Angeles	23,041	844,869	867,910	2,605,440	33.31
Madera	1,803	507,933	509,736	1,374,720	37.08
Marin	6,826	5,395	12,221	333,440	3.66
Mariposa	3,509	447,896	451,405	931,200	48.47
Mendocino	78,321	324,932	403,253	2,246,400	17.95
Merced	6,848	13,796	20,644	1,269,120	1.63
Modoc	25,217	1,749,592	1,774,809	2,620,160	67.73
Mono	21,224	1,555,948	1,577,172	1,948,800	80.93
Monterey	12,850	690,333	703,183	2,127,360	33.05
Napa	10,961	64,499	75,460	505,600	14.92
Nevada	6,190	249,323	255,513	626,560	40.78
Orange	3,892	58,026	61,918	500,480	12.37
Placer	4,877	293,863	298,740	915,840	32.62
Plumas	8,829	1,171,360	1,180,189	1,644,800	71.75
Riverside	169,839	2,443,228	2,613,067	4,594,560	56.87
Sacramento	6,215	12,011	18,226	630,400	2.89
San Benito	7,976	128,226	136,202	893,440	15.24
San Bernardino	483,722	9,561,948	10,045,670	12,883,840	77.97
San Diego	469,532	832,185	1,301,717	2,725,120	47.77
San Francisco	996	3,639	4,635	28,800	16.09
San Joaquin	5,061	4,772	9,833	902,400	1.09
San Luis Obispo	23,743	338,303	362,046	2,128,640	17.00
San Mateo	4,829	1,019	5,848	290,560	2.01
Santa Barbara	6,548	759,672	766,220	1,756,800	43.61
Santa Clara	7,717	23,481	31,198	835,200	3.73
Santa Cruz	16,615	71	16,686	280,960	5.93
Shasta	30,859	976,792	1,007,651	2,461,440	40.94
Sierra	6,388	371,204	377,592	613,120	61.58
Siskiyou	20,925	2,510,608	2,531,533	4,040,320	62.66
Solano	16,800	12,520	29,320	529,280	5.54
Sonoma	16,213	24,405	40,618	1,010,560	4.02
Stanislaus	2,685	22,248	24,933	963,840	2.58
Sutter	5,344	1,279	6,623	388,480	1.70
Tehama	52,986	436,031	489,017	1,903,360	25.69
Trinity	15,544	1,456,984	1,472,528	2,042,240	72.10
Tulare	13,894	1,549,278	1,563,172	3,100,800	50.41
Tuolumne	4,820	1,092,425	1,097,245	1,456,000	75.36
Ventura	6,602	575,949	582,551	1,188,480	49.02
Yolo	6,148	34,170	40,318	661,760	6.09
Yuba	2,653	118,375	121,020	408,320	29.64

FEDERAL LANDS

Although there is a need for a more exact inventory of federal lands in California, federal policy relative to ownership, acquisition, disposal, and land management is more important to the economy of the State than the actual area in federal ownership at any one time. The amount of land owned or controlled by the various federal agencies changes from time to time due to changes in the law by Congressional action or policy changes made by federal agencies.

The act of Congress admitting California provided for federal ownership and control of public lands and for their exemption from all taxation. Approximately 10 percent of the total land area in California had entered into private ownership under Spanish and Mexican grants. Title to these grants was confirmed by the Land Claims Commission (1851-1856) and the courts. The boundaries of some of these rancherios were vaguely defined and the early land surveys conducted by the Federal Government in other areas were incomplete and, in some cases, inaccurate. The need for complete and accurate surveys for federal land is still an urgent need in various counties in California where federal ownership predominates.

The pattern of federal ownership established when California and the other western states were admitted to the Union is thus substantially different from the problem of land ownership of the other states. The demand for land began with the discovery of gold in 1849. The need for private ownership of land, however, was not confined to mining. The influx of population required the use of additional land for agriculture and other purposes. This need was met by a series of laws enacted by Congress for the disposition of some of the federal lands. The provision for swamp land grants (1850) was one of the first measures enacted for dispersal of the lands in the public domain. The methods adopted for obtaining lands under these provisions have provided interesting anecdotes in California history. One of these was to comply with the law for establishing claim by the use of covering the area by boats placed on wagons and hauled over dry land.

School land grants, homestead grants, provision for grants of isolated and mountain tracts, and a variety of other laws providing various methods for disposition of public domain lands gradually reduced the amount of federally owned lands to less than 50 percent of the land area of this State. The concept of conservation of natural resources which appeared at the turn of the century started a trend which renewed the process of disposal of land in the public domain. One illustration of this trend was the cession of Yosemite Valley and Mariposa Big Tree Grove to California in 1864 and their recession in 1906. The establishment of forest reserves in 1891 and 1897 inaugurated a policy of withdrawal of lands from the public domain for specific uses and purposes. Additional withdrawals have been made for reclamation and other special purposes.

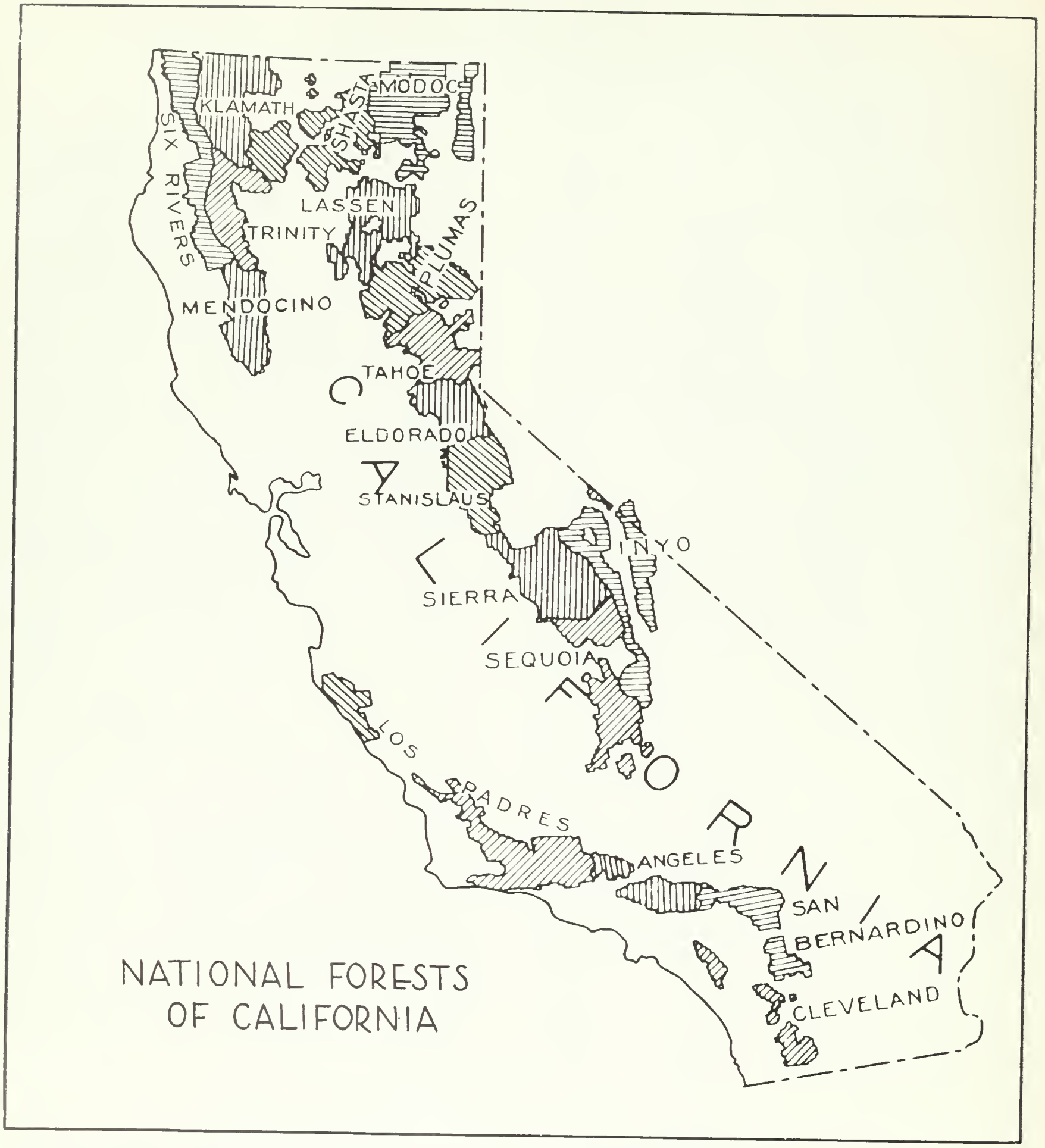
National Forests

Most of the federally owned lands in California are administered by the Federal Departments of Agriculture, Interior, and Defense. The Forest Service of the Department of Agriculture administers the lands included in national forest areas. There are approximately 20 million acres of California land included in national forest areas. About half of these lands, however, are range lands or lands unsuited to forest production. The national forest areas also include some five and a half million acres of privately owned land within their areas.

Some of the land withdrawn from the public domain for national forest areas have been transferred to other federal agencies for specific purposes and some have been sold. In addition acquisition of additional lands have been made by exchange practices authorized by acts of Congress in 1922 and 1925, purchase, and donation. The principal purpose of such acquisitions, as stated in the 1949 Yearbook of Agriculture, "is to place in government ownership—that is, ownership by all citizens—the forest lands in or near the national forests that will not be given suitable treatment in private ownership or that would otherwise best promote the public interest by being publicly owned—vital watersheds, for instance, or lands needed to round out timber-management units."

The exchange method has been the principal means of acquiring additional forest area lands in California in recent years. Exchange methods are also of particular interest to California inasmuch as the application of this method has expanded the total national forest area in this State. Although the Exchange Act authorizes the exchange of both forest *lands* and *timber*, the general practice in California has been to exchange only the cutting rights to timber in the national forests for privately or state-owned lands. This procedure results in the retention of existing forest *lands* and the acquisition of additional lands to the forest areas. Some of the effects of this practice on the economy of some of the counties in California were discussed in the 1951 report of this committee.

One of the principal arguments for consolidating the federal holdings in national forest areas is based on the "multiple-use" principle of land management adopted by the Forest Service. An article in the 1949 Yearbook of Agriculture states that, "The essence of multiple use management is to make each area yield the maximum number of benefits and to fit each use to the other. Exclusive right of way is given to one use only where that use is clearly dominant." The multiple-use principle of land management contains many elements of conflicts of interest. A heavy de-



mand for timber products such as occurred during and after World War II necessitates complicated adjustments of timber appraisal policies and procedures to assure equitable prices for both small and large timber operators. Timber sales policies must also be adjusted to the demands of forest protection policies and the needs of sustained yield programs. The rights of owners of mining claims also conflict with the policies of timber management. Grazing rights frequently conflict with game management and other forest uses. The need for suitable recreation areas in national forest lands represents another type of conflict in the application of the multiple-use principle of management. Such conflicts tend to multiply as

the population of the State increases resulting in additional need for land and land use.

Public Domain

The amount of federal lands managed by the Department of the Interior in California slightly exceeds the amount managed by the Forest Service of the Department of Agriculture. These areas were approximately the same 20 years ago. The increase in the amount of Interior lands was due to the release of railroad land-grant claims pursuant to the provisions of the Transportation Act of 1940. These lands were added to the public domain lands administered by the Bureau of Land Management.

The National Park Service, the Bureau of Reclamation, the Bureau of Indian Affairs, and the Fish and Wildlife Service also administer some of the California public lands under the control of the Department of the Interior. Some of these specific uses of federal land in California are particularly important to this State. The amount of land under the jurisdiction of the Bureau of Reclamation, for example, is about 4 percent of the total federal land area in California. This area, however, is 30 percent of all land in the United States under the jurisdiction of the Bureau of Reclamation and is by far the largest area in any state under the jurisdiction of this bureau.

The bulk of the Interior lands in California, however, are administered by the Bureau of Land Management. These are the lands in the public domain which are not withdrawn or reserved for specific use. These lands are also subject to disposal for private use under various acts of Congress. Public domain lands exist in all counties in the State except Marin, San Francisco, and Sutter. Some of these lands are forest areas, some are grazing lands, and some are waste lands. The vast checkerboard pattern of land in the public domain complicates the problems of land management in these areas.

Timber Trespass

One of the difficult problems of land management of particular concern to the Bureau of Land Management, the Forest Service, and private land holders is that of trespass in the forest areas. Trespass problems were considered at the Los Angeles hearing of this committee, October 25 and 26, 1956. A number of witnesses testified that a considerable amount of valuable timber was lost due to inaccurate surveys or improper location of cutting lines established by timber operators. Witnesses also testified that wilful trespass also accounted for some timber loss.

The scattered lands of the Bureau of Land Management make trespass difficult to detect or correct. A representative of this bureau testified that the small staff of bureau foresters could not police the entire area that sales and other forest management activities might have to be delayed unless the trespass problem could be controlled. The bureau has investigated cases of wilful trespass where they have been told that the person who committed the trespass had said that that was the cheapest way to get the timber since, if payment were demanded, the amount paid would not be near as much as the timber is worth.

The reason for such statement is that the law provides for treble damages in the case of wilful trespass but that wilfulness is hard to prove. Wilful trespassers also have no regard for good forest management. This creates fire hazards and loss from erosion as well as the destruction of young trees.

A representative of the United States Forest Service testified that trespass is also becoming more and more of a problem in the national forest areas. These problems have become more difficult with the upsurge of numbers of mills and amount of cutting in California during the past 10 years. The increased amount of timber sales in the national forests also reduces the personnel available for checking on trespass and working on trespass cases.

The problem of timber trespass on private lands in the northwest part of the State was described by a representative of the Simpson Redwood Company as follows:

> "The problem which we find ourselves in is that what you might call itinerant loggers go into an area and commence logging where they have either thought they had purchased timber or wanted to buy timber and they did not. The land surveys are erratic; they are old, indefinite. They proceed to trespass on adjoining ownerships, and, after the trespass has occurred and the timber has been removed, there is an attempt to seek some type of remuneration from those people. Usually, it is impossible to make any collection from them, first, because they thought they were on their own land and generally the courts do not recognize the full value of timber and the landowner on whose land the timber was cut only receives a nominal amount of money for his damages.
>
> "What needs to be done, in our opinion, is that it should be the responsibility of a logger to determine where his land lines are, where his survey lines exist, and if he goes over those lines, then that should be evidence that it was malicious and willful trespass and that he should be assessed the statutory assessment of triple stumpage. I believe the problem is as simple as that. And, to repeat it, the operator, the logger, is clothed with the responsibility of determing that he is logging on property which he owns; and if he logs on property that he does not own, then that is evidence that the trespass is malicious and willful and should receive an assessment of triple damages for the timber which was removed."

The chairman then cited specific examples as follows: "The official federal survey in the area of Trinity County, which is approximately the place they call Helena, is in places at least a mile off. The official federal survey in the area in the vicinity of Big Bar and Burnt Ranch in Trinity County was so far off that it was officially canceled. Even though people in that area have lands which have gone to patent, they have a difficult time now trying to determine where they are, and each time there is a new survey, the man who has been occupying land for the past, say, 75 or 100 or 120 years, he or his predecessors in interest, now finds that he is probably a quarter of a mile or a half mile from his actual homestead. We find that situation prevailing throughout most of that timbered area, so that there is something to be said, and I'm certainly not excusing these willful trespasses because we know they go on, but I have had situations where you owned land and the Forest Service and everybody else thought they knew where the lines were, then, when another survey would be made, you would find that the survey was swinging either north or south and the pine stand that the Forest Service thought it owned probably was owned privately or vice versa."

The chairman then questioned the witness as follows:

Q. "I am stating that as what I see in everyday life and I am wondering if you would care to comment on that?"

A. "Yes, I would like to. In each county we have in California a system of registering our land surveys. They are at each county seat and they are recognized by the State, by a board. I don't know which board it is, but they are authorized to perform their function as a land surveyor by the State.

"The land that they would survey, and line that they would survey could generally be accepted as the proper division between two properties. So, I don't believe that is much of a problem—we know that in Northern California, particularly in the rougher regions, the rough areas have been very poorly surveyed and, in some instances, they probably were not surveyed at all, but these lines and approximate subdivisions were dubbed in by paper work. But, nevertheless, if a registered land surveyor, of which there are a number in the State and they are represented in each county, if they would be consulted and if they would be employed to run these lines prior to the time that the logging occurred, then I think the adjoining ownership would not have any quarrel with his findings.

"The exception which you have mentioned in the more remote areas certainly cannot be resolved in that manner, but where our timber resources are very heavy and where they will justify the expense of this survey, I believe a requirement that a registered land surveyor who would register his survey in the county courthouse, mark the lines in properly, would eliminate 90 percent of our problems at present."

Q. "What would you do in a place where you can't get within five or six or eight miles of an established corner, probably, and a small owner of 160 acres of land with timber on it would like to have his timber harvested? What could he do? He certainly couldn't hire that surveyor to come in and establish his lines."

A. "Well, you are, of course, talking about the 10 percent which I recognize that does exist. I have encountered some of these problems in the past. We have handled them in one or two ways. Number 1, we agree jointly; that is, the two parties agree jointly where the lines are according to the best information that they have and which they can make available.

"If there is a dispute and there is an extreme distance between the two lines, where they think they should be, then that thing just doesn't get taken care of except by the courts and it never is solved and I think there are a lot of them laying on the docket now. I know there are two or three in Del Norte and Humboldt Counties.

"But what I am principally concerned with is those people who go in and buy some timber and commence logging that timber, and they never make any attempt to determine where the lines are. Consequently, they trespass on adjoining ownership. They are brought into court in an endeavor to seek some restitution from them, and their plea is that they tried to find the lines, they couldn't find them very well and they thought they were here, or somebody told them that they were in such a location. After the trespass has occurred, it is very difficult to collect damages. In fact, it is impossible to collect any more than a nominal amount for your stumpage."

National Defense Lands

The third largest amount of federal lands in California are those under the control of the Department of Defense. A report prepared by the General Services Administration for the Senate Appropriations Committee, Eighty-fourth Congress (1956) shows that such lands are now in excess of 4,000,000 acres as follows: Army, 973,066 acres; Air Force, 426,940 acres; Navy, 2,719,851 acres; and Corps of Engineers, 64,145 acres.

Military lands have increased from 442,498 acres in 1937 to 4,184,003 in 1956. This is an increase of almost 1,000 percent in the past 20 years. Approximately 2,000,000 acres were added from 1937 to 1949 and about $1\frac{3}{4}$ million acres added since 1949.

The acquisition of additional lands by the Federal Government has been a problem of primary concern of the Senate Interim Committee on Public Lands since its creation in 1949. As noted above, the 1951 report of this committee discussed some of the problems of acquisition of national forest lands. At least four hearings were held by this committee in 1951 and 1952 on problems of acquisition of land for Navy use in Inyo and acquisition and retention of land at Camp Beale Air Force Base. The Inyo lands were withdrawals from the public domain. These lands, however, were mineral lands of value to the economy of the county.

Camp Beale, consisting of 86,000 acres was originally acquired by the Army shortly after the start of World War II. Some owners sold under threat of condemnation and others required the Government to condemn the land. This land had been used for both grazing and mining. Most of the landowners retained the mineral rights when the Army acquired the land although they agreed that they should have no access to their mineral rights for a period of 10 years.

At the close of World War II, it appeared that the Army would have no further use for Camp Beale and that the former owners might have an opportunity to buy back their lands. The Air Force, however, claimed the site for a bombing and gunning range for the Mather Field Training Command in 1945.

The former owners of Camp Beale lands organized the Nevada-Yuba Landowners Association to protect their interests. The secretary of this association testified at a hearing of this committee that the Air Force proposed to condemn the mineral rights at the termination of the 10-year agreement of the owners to refrain from access to their mineral rights until 1952. The former owners expressed willingness to extend the nonaccess agreement for another 10 years but protested the proposed condemnation of the mineral rights inasmuch as such rights give the former owners some hold on the land in the event that this area or some portion thereof be declared surplus.

The Senate Interim Committee on Public Lands supported the position of the Nevada-Yuba Landowners Association by letters and resolution. The Air Force reached a decision early in 1952 to accept the association's offer to extend the moratorium on the exploration of mineral rights for another 10-year period at no cost to the Government.

Four years later, the secretary of the landowners' association testified at the hearing of this committee in Sacramento, July 14, 1956, that the Air Force had again requested funds to acquire the mineral rights at Camp Beale Air Force Base by condemnation if necessary. The witness also testified that if the mineral rights were acquired by the Federal Government, another 86,000 acres of California land will pass irrevocably into federal ownership.

Camp Beale Air Force Base was in a caretaker status at the time of this hearing although an appropriation of some $9,000,000 had been improvements to this base. The former landowners contended that even if the base was to be reactivated, it was not necessary to retain all of the 86,000 acres for this purpose. The secretary of the association testified that the lease of a substantial portion of the area to the former owners for grazing purposes supported their contention that at least some of the land could be declared surplus. This committee supported the position of the former owners and adopted a resolution to the effect that the Air Force be urged to determine how much of the 86,000 acres was needed for Air Force purposes and that the balance of this acreage be declared surplus.

STATE LANDS

Many of the problems considered by the Senate Interim Committee on Public Lands with respect to state-owned lands are similar to the problems arising from the ownership of California lands by the Federal Government. The principal difference is one of magnitude since the federal lands account for 46.14 percent of the total land area of the State whereas the 2,268,873 acres in state ownership represent 2.26 percent of the total area.

The purposes for which land is owned by the State are, in general, similar to those of the federal lands. One exception is the 400,000 acres of tax-deeded lands held by the State until redemption or sale with the proceeds of sales being returned to the local taxing districts. The balance of the land in state ownership is about evenly divided between the state school and submerged lands and the lands in departmental control.

The principal agencies administering the public levels owned by the State of California are as follows:

Agency	*Use*	*Acres*
State Lands Commission	School and submerged lands	852,888
Reclamation Board	Flood Control	8,996
Department of Fish and Game	Fish and Game Management	89,966
Department of Natural Resources		
Division of Forestry	State forests	71,060
Division of Beaches and Parks	Beaches and parks	560,628

The State Lands Commission and the Lands Division of the Department of Finance administer the tide and submerged lands and the state school lands. This is a land management agency whose functions are similar to those of the Federal Bureau of Land Management in the management and disposal of the federal lands in the public domain. The flood control

functions of the Reclamation Board are similar to those of the U. S. Corps of Engineers. The fish and game management activities of the Department of Fish and Game are similar to those of the Federal Fish and Wildlife Service. The management of the beach and park lands and the administration of the historical monuments by the Division of Beaches and Parks, Department of Natural Resources, under the supervision of the State Park Commission, are similar to the activities of the National Park Service. Some of the activities of the Division of Forestry of the Department of Natural Resources such as fire protection are similar to those of the Federal Forest Service. One of the principal differences between these two forest service agencies, however, is that the U. S. Forest Service manages the lands in the national forests whereas the relatively small amount of acreage in the state forests is used for experimental purposes. Another importance in the activities of these two agencies is that the Forest Practice Act administered by the Division of Forestry applies to privately owned lands whereas similar activities of the U. S. Forest Service apply only in the national forest areas.

There is also great similarity in the public land problems of both federally-owned lands and state-owned lands. The problem of determination of the amount of lands that might be declared surplus and returned to the tax rolls, described above in connection with Camp Beale Air Force Base, for example, has its counterpart in connection with some of the land under control of the Reclamation Board. This problem was considered at the hearing of this committee in Sacramento, July 13, 1956.

Approximately 1,500 acres, or 15 percent of the total lands under the control of the Reclamation Board are in Solano County. A representative of the Rio Vista City Council testified that this land was not used for flood control purposes and that a portion of this acreage was leased for farming purposes. This representative also testified that the board had considered disposition of this land in 1949 or 1950 but had subsequently decided on retention. Dugald Gillies, representing Senator Luther Gibson of Solano County, testified concerning the difficulties encountered in requesting the Reclamation Board to reach a determination on the necessity of holding this land in public ownership. This testimony, in part, is as follows:

> "We believe that there may be lands held by the Reclamation Board in our county and possibly in other counties which are surplus to their present requirements and on a reasonable basis may be considered surplus to future requirements. To cite an example, interests in the community of Rio Vista approached the Reclamation Board in 1953 requesting consideration for the sale of certain lands which had apparently originally been acquired as spoils areas for dredging operations of the U. S. Army Engineers. Senator Gibson contacted the Reclamation Board in the fall of 1953 regarding this matter and we were advised that they would review the possibility of the disposal of this land at that time.
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> "Over one year later in December, 1954, we submitted an additional inquiry as to what progress was being made and were advised that the Reclamation Board had 'just recently requested the services of an appraiser to appraise' the property in which interest had been expressed, and further, that upon the receipt of this appraisal the board would 'advertise for bids on the sale of this property.' Again, in June, 1955, we solicited information on any action which might have been taken and were advised that the appraisal had been submitted to the Reclamation Board at the meeting of April 20, 1955, and at that time was referred to a committee of the board for review and a report at its meeting May 4th. The recommendation of the committee concerned was that the property not be offered for sale and, therefore, they had apparently closed the file on the matter.
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> "Subsequent correspondence developed the statement that the action to withhold this land from sale and therefore consequent return to the tax rolls was determined 'after giving consideration to the possible need for spoil disposal areas in connection with the construction of the Sacramento Deep Water Channel and also in connection with the possible construction of a barrier at Junction Point as a part of the Biemond Plan.'
>
> "I believe that it will be common knowledge to the committee that the Congress of the United States has not made any appropriations to the Sacramento Deep Water Channel project for a considerable number of years and therefore, the indefinite holding of land in the Rio Vista area for possible use in connection with that project cannot in our opinion constitute a reasonable premise for retention of this land in state ownership. It should be emphasized also that there is no concrete plans for the use of this or any other tract of land in this area in connection with the Sacramento Deep Water Channel even should appropriations become available.
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> "On the second advanced reason for withholding this land which relates to the proposed Biemond Plan, the board advised us in response to another inquiry that 'while we have no information that this particular land can be utilized in connection with the Biemond Plan or any plan which might be an outgrowth thereof, we are cognizant that this plan exists and that it involves future construction in the general area. At the time the decision was made not to sell this Rio Vista property we were not informed as to whether or not it might be neces-

sary in connection with the construction of the Biemond Plan or some modification therefor.'

"The board concluded its statement in this latter communication of September 8, 1955, by saying 'the Reclamation Board has held the Rio Vista spoils area for many years. The board sees no reason for offering it for sale until all reasonable means have been taken to determine that the land will not be necessary for some public purpose within the foreseeable future'."

Beaches and Parks

The State Park Commission determines the policy for acquisition and development of the land in the State Park System. Beach and park lands constitute over half of the state lands under departmental control. These lands are administered by the Division of Beaches and Parks of the Department of Natural Resources in accordance with the policies determined by the State Park Commission.

The State Park Commission was established in 1927. The Legislature, however, has not provided any substantial guide lines for the determination of park policy by the commission. Section 506 of the Public Resources Code, for example, provides that "General policies for the administration, protection, and development of the State Park System shall be determined by the State Park Commission which shall consist of five members appointed by the Governor, with the advice and consent of the Senate." Section 5003 of the same code provides in part that: "The State Park Commission shall administer, protect and develop the State Park System for the use and enjoyment of the public. It may establish rules and regulations not inconsistent with law for the government and administration of the State Park System." Section 5006 provides that the commission, with the approval of the Department of Finance, may acquire, by purchase or condemnation, title to or any interest in real or personal property which the commission deems necessary or proper for the extension, improvement, or development of the State Park System.

The criteria developed by the State Park Commission for state park areas is stated in a resolution adopted by the commission, October 19, 1956. This resolution is as follows:

RESOLUTION ADOPTED BY STATE PARK COMMISSION

October 19, 1956

Resolved, That the California State Park Commission, in order to indicate the basis of selection of state park areas, approve and reaffirm the following principles:

STATE PARK CRITERIA

Ever since the Legislature in 1927 authorized the establishment of a *State Park System*, and by statute (Public Resources Code, Section 5006) empowered the State Park Commission to acquire, as a part of that system such lands and other properties as "the commission deems necessary or proper for the extension, improvement or development of the State Park System," there have been definite criteria for the establishment of state parks.

These have been used as a guide by the commission in the acquisition of state park lands in accordance with their understanding of the state park concept since the founding of the system. They have been frequently stated, notably in four documents: (1) The Olmsted Survey and Report to the Legislature (Chapter 764, Statutes of 1927); (2) Statement by the original State Park Commission in 1928, entitled "State Parks—What Are They?", (3) Supplementary Olmsted Survey of 1950 (Section 1, Chapter 1422, Statutes of 1945); and (4) The Five-Year Master Plan, 1956.

These criteria involve certain principles:

1. Areas in the State Park System should be of state-wide and not local significance.
2. They should possess outstanding qualities of landscape or features of special significance that make their preservation and public recreational use a matter of state-wide concern.
3. They should be on a scale worthy of inclusion in the state system.
4. They should be unified and complete areas with logical boundaries.
5. State parks are primarily natural areas. Developments are for the purpose of making the areas available for public enjoyment in a manner consistent with the preservation of natural attractiveness and should be of the simpler sorts in a natural environment (i.e., camping, picnicking, sightseeing, nature study, hiking, riding, boating, swimming, fishing, etc.) involving no major modification of their lands, forests and waters, and without extensive introduction or artificial features such as athletic fields, playgrounds, golf courses, and other forms of recreational developments that primarily are for local benefit.
6. Funds for the State Park System are not intended to be used as a subsidy to local recreational developments. Important as these are, they have traditionally been considered as the responsibility of local communities, and are not a part of or related to the State Park System, which supplements on a state-wide basis the local recreational provisions.
7. The state park areas should be equitably distributed so as to assure proper balance in their use by the citizens of all parts of the State, but not necessarily located in specific communities on the basis of population or area. The state-wide value of the present State Park System is shown by the fact that a majority of the visitors to many remote parks come from the populous

Golf Course, Morro Bay State Park, San Luis Obispo County

centers of the State. One of the primary purposes of the state parks is to afford city dwellers the benefits of life in the open country; therefore, county lines cannot be taken as the basis of distribution of parks, but rather the determining factor should be the availability of the types of lands that can most satisfactorily afford the sorts of outdoor recreation that are characteristic of state parks.

8. In determining the value to the different parks of the State of areas proposed for state park purposes, not only should reasonable accessibility to the entire population be taken into account, but also the relative cost to the State in terms of the types of recreation characteristic of state parks.

The above and other established principles have been followed by successive State Park Commissions in building up the State Park System, and according to the experience and understanding of the State Park Commission have been generally supported by the Legislature and the people of the State. They are the basis of action by the State Park Commission in carrying out the responsibility placed upon it by the Legislature.

This resolution rejects the concept that lands in the State Park System should be used for group recreational purposes such as athletic fields, playgrounds, and golf courses. The commission decided that such forms of recreational development primarily serve areas of local interest and should not be included in the State Park System.

The Legislature provided $4,000,000 in the budget for the 1956-57 Fiscal Year for the acquisition of seven park areas and the development of two park areas in Los Angeles County. Five of these nine projects had the approval of the State Park Commission. The other four projects were rejected by the commission as being recreational projects of local rather than state-wide interest in accordance with the criteria included in the above resolution dated October 19, 1956. In making this determination, the commission disregarded the intent of the Legislature to acquire these areas as expressed by the appropriations for these specific projects.

The hearing of this committee in Los Angeles, October 25, 1956, developed testimony to the effect that such areas were necessary for the recreational needs of a large portion of the State's population. It was also contended that it was to the interest and benefit of the State to acquire and develop such areas for the use of tourists from other parts of the State and Nation. After hearing the testimony, the committee adopted a motion recommending that the State Park Commission proceed with the immediate acquisition of those beach and park sites within Los Angeles County, for which appropriations were made in the 1956 Budget Act, with the exception of the site or sites withdrawn from consideration by mutual agreement.

The committee also adopted a motion recommending that legislation be introduced at the 1957 Session of the Legislature to authorize and direct the committee to go forward with a mandate of the Legislature whenever such mandate is expressed by an appropriation and direction is made. A recommendation was also made that appropriate legislation be drafted and introduced directing the State Park Commission to broaden its criteria for the qualification of property for state park purposes to include areas suitable for mass recreation whenever such areas are of benefit to reasonably large segments of the State's population.

The committee also heard testimony relative to the "multiple-use" principle of park land management with particular attention to the use of the park lands for mining and hunting. The Anza Desert and Borrego State Park in San Diego County comprises approximately 60 percent of the total lands in the State Park System. State Route 78 separates these two park areas. Borrego State Park consisting of 175,264 acres is south of the highway.

Witnesses at the Los Angeles hearing testified that most of the Anza Desert lands were not suitable for park purposes and should be released for other purposes. Although this area was withdrawn from the public domain for park purposes, the Federal Government did not release the mineral rights and several mining claims are being worked in the area.

The Division of Beaches and Parks has recently restudied the boundaries of these two park areas and has proposed both additions and deletions. Most of the proposed additions are in the Borrego State Park and the recommended deletions are in Anza Desert State Park. Proposed additions amount to 7,760 acres and the total deletions are 59,260 acres or net deletion of 51,500 acres for the two park areas.

The deletions of approximately 60,000 acres include most of the mining areas. Some grazing areas are also included in the recommended deletions. The State Park Commission has leased some of the park area for grazing purposes but proposes to terminate such leases inasmuch as the general policy of the commission is that park lands should be used for park purposes only. The Joint Legislative Committee on Agriculture and Livestock is investigating the need for grazing leases in state park areas.

PUBLIC LAND USE AND BENEFITS

The similarity of public land uses, land management agencies, and public land problems of both state and federal lands in California was noted in the first report of this committee. The 1951 report stated that "The duplication of activities of the State and Fed-

eral Governments in the management of public lands for similar purposes raises two fundamental questions: (1) does public ownership of extensive land areas constitute the best solution to the problem of conservation and management of the natural resources of the State? and (2) what agencies at which level of government, state or federal, are best suited to administer the necessary management program? * * * The Senate Interim Committee on Public Lands has only scratched the surface of many related problems and recognizes the need for more study and analysis of the impact of public lands upon the economy of the State."

The committee has continued its studies of the problems and reported its findings in this and other reports. In the meantime other studies are also being made as a result of the realization of the need for further study and analysis as suggested in the 1951 report. One of these other inquiries is a study of land ownership in California under the auspices of the American Forestry Association.

The study of California land ownership now under way by the American Forestry Association was made possible by a grant from the Nutrilite Foundation of California. The American Forestry Association appointed a Forest Landownership Study Committee with DeWitt Nelson, Director of the California Department of Natural Resources as chairman to make the necesary arrangements for the study. The purpose of the study is to lay a sound foundation for intensive studies of landownership in California by identifying major problems and suggesting approaches to their solution, with special reference to timber, range, watershed, and recreational uses. The outline developed by the study committee states that this study "is an integral part of the program of the American Forestry Association to stimulate both national and state-by-state studies of the landownership situation. State studies are essential to assure adequate consideration of local conditions and problems, while a national study is essential to assure adequate consideration of interstate relations in which regional and national interests are involved. The association hopes to make pilot studies in three states with widely varying forest conditions and ownership patterns. The California project is the first of these studies."

The Forest Landownership Study Committee reports that the significance of this study is as follows:

> "Ownership of the timber, range, watershed and recreation lands of the United States is one of the most crucial factors in determining the effectiveness of their contribution to the economic and social well-being of the State and Nation. The character of the ownership affects such vital matters as purpose, stability, and intensity of land management; feasibility of multiple-use management; establishment and stability of wood-using and other industries; community support in the form of taxes or contributions in lieu of taxes.
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> "The land-disposal and later the land-reservation policies of both the Federal and State Governments have led to an unplanned and often illogical pattern of ownership. The situation is complicated by the wide variety of agencies to which administration of the publicly owned lands has been assigned, and by the division of ownership between large and small private owners. What percentages and what kind of timber, range, watershed and recreational lands in the various states should be in federal, state, community, corporate, farm, and other ownership, and what pattern these ownerships should form are examples of questions to which no clear answers are at present available. Study and improvement of the land ownership pattern are essential to assure the sound development of the economy on a permanent basis.
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> "The urgency of the study is emphasized by the population explosion that is occurring in the United States in general and in California in particular. The rate at which the population of the State has been growing, and will undoubtedly continue to grow, is placing a steadily increasing strain on its natural resources, with resulting competition for their allocation to different uses, which has an important bearing on ownership problems"

The studies of federal and state ownership of California lands that have been made by the Senate Interim Committee on Public Lands and the hearings on various types of specific public lands problems in various parts of the State have convinced this committee that there is a definite need for legislation to establish a coordinating committee of the several state land management agencies to advise the Governor and the Legislature with respect to natural resource policies. This committee should also have the assistance of an advisory committee representing the public and the various industries directly concerned with the development, use, and conservation of the natural resources of the State.

The study being conducted by the American Forestry Association will undoubtedly suggest the need for continuing studies of public land problems. The experience of this committee has been that such problems are constantly changing and, therefore, are in need of continuous study. The committee also believes that its exploratory studies have indicated the need for specific and comprehensive analysis of these problems should be made by the executive branch of government as well as those conducted by the legislative branch. The coordinating and advisory committees suggested above could coordinate the necessary public land studies of all agencies of the executive branch of government which are directly concerned with these problems.

CHAPTER 3

PAYMENTS IN LIEU OF TAXES

One of the hard facts of property taxation, which is the backbone of local government revenue, is that an exemption from taxation of one group of property owners increases the tax burden of the other property owners in the taxing district. Federal and State Governments own 50 percent or more of the land in approximately one-fourth of the counties in California.

Public land ownership in some instances produces benefits to the areas in which such land is located. The studies of this committee, however, show that the benefits received from public ownership of land do not compensate for the exemption of such land in several California areas where such ownership results in definite hardships to the local units of government.

Since federal ownership predominates in some counties, the greatest hardship to local governments comes from this class of tax exempt land ownership. The first efforts of the Senate Interim Committee on Public Lands, therefore, were directed toward relief from this hardship by appearances before congressional committees and sponsorship of resolutions urging in lieu tax payments on the land owned by the Federal Government.

Members of this committee, representatives of the County Supervisors' Association, and others met with the members of the Commission on Intergovernmental Relations in Washington in 1954 in connection with the commissioner's study of in lieu tax payments. The recent report of this commission recommended that Congress enact a general system of payments in lieu of taxes on federally owned land. Such legislation has been proposed by members of Congress from California and other states for a number of years. The added support of the Commission on Intergovernmental Relations, however, confirms the need for such payments as advocated by this committee.

STATE PAYMENTS IN LIEU OF TAXES

The principle of payments in lieu of taxes to local governments for lands in state ownership in California is firmly established for certain types of land owned by the State. Such payments are made for lands included in the state forests. Payments in lieu of taxes are also made for lands withdrawn from the public domain by the State for fish and wildlife purposes. Legislation has been introduced in recent years for such payments to be made for types of land in state ownership.

Senate Bill No. 1789 introduced at the 1955 Regular Session of the Legislature as the result of the studies and investigations of this committee proposed that payments in lieu of taxes should be made by the State for lands used for beach and park purposes. This bill was passed by the Legislature but was vetoed by the Governor. One of the reasons for the veto was that some of the state-owned beaches and parks were areas of predominantly local interest and that additional benefits in the form of payments in lieu of taxes should not be added to the benefits resulting from recreational uses provided by the State.

The veto of the 1955 legislation sponsored by members of this committee resulted in further consideration of this problem during the 1955-56 interim. The subject of payments in lieu of taxes for state beach and park lands was included in the agenda for the hearing of this committee in Sacramento, July 13 and 14, 1956. Testimony in favor of such payments was presented by William McDougall, General Manager, County Supervisors' Association; DeWitt Nelson, Director, Department of Natural Resources; Guy Hedrick, Supervisor, Del Norte County; and Robert E. Hanley, representing the California Farm Bureau Federation. Additional testimony on the need for payments in lieu of taxes was presented at the Los Angeles hearing, October 25 and 26, 1956, by Robert Landagin, District Attorney, Inyo County; Verne Summers, representing Inyo and Mono Counties; and C. E. Hawthorn, Assessor, Tuolumne County.

The basis for payments in lieu of taxes proposed by Senate Bill No. 1789 was that of land use. This is the basis for payments made for state forest land and land used for fish and wildlife purposes. Other criteria considered by this committee include: (1) the relationship of the amount of land owned by the State for beach and park purposes to the total land area of the county or other taxing district; and (2) the relationship of the assessed value of the state-owned land to the total assessed value of the county. Both of these methods were advocated by the general manager of the County Supervisors' Association as a means of relief for the most severe hardships found in some of the counties as a result of state-owned land used for beach and park purposes.

Area, per se, does not represent the hardship resulting from the loss of land from the tax rolls. The state-owned beach and park lands in San Diego County, for example, amounting to about 420,000 acres or 15 percent of the total 2,725,120 acres does not necessarily represent a 15 percent loss in the value on the tax rolls since approximately 400,000 acres are desert lands of little value.

The second alternative basis for payments in lieu of taxes on state-owned beach and park lands presents

two types of difficulties: (1) determination of the value of such lands; and (2) the relationship of the value of such lands to the total assessed value of the county. The first type of problem is the least difficult to solve. The value placed by the county assessor would probably be accepted by the Division of Beaches and Parks in most cases. A means of arbitration could be used in cases of substantial differences as to value.

The relationship between the value of the beach and park lands and the total assessed value of the taxing district would probably have to be determined arbitrarily. The data in Table 2, for example, show the estimated payments in lieu of taxes that would be made on the basis of payments on the value of beach and park lands in excess of 2 percent of the total accrued value in the county. Four counties would receive annual payments in lieu of taxes as follows:

County	*Payment*
Del Norte	$73,374
El Dorado	42,285
Humboldt	93,520
Santa Cruz	34,958
Total	$244,137

The total annual cost to the State on this basis would then be less than $250,000. If the selected base was less than 2 percent of the total assessed valuation, the payments to these counties would be more. A lower percentage would also include payments to additional counties.

A third alternative was discussed in the 1955 report of this committee. This plan was suggested by the Canadian system of payments to local governments in lieu of taxes. This plan would include the determination of local benefits accruing from state ownership as a basis for such payments. Under this plan there would be at least three types of park lands classified according to local benefits. Class A lands would include the state lands which do not contribute significantly to the local economy. Payments for Class A lands would be on the same basis as similar lands on the tax rolls. Class B lands would include the state lands which do contribute substantially to the local economy. No payments would be made for Class B lands. Class C lands would be the state-owned lands benefiting the local economy to some extent. Some payments would be made for such lands but not as much as Class A lands.

The principle of payments in lieu of taxes based on use do not consider the need that some of the counties may have for added costs of government that increase the burden on restricted tax rolls. The alternative methods discussed above give recognition to the hardship cases.

As indicated by the data on Table 2, the actual cost to the State of the proposed payments in lieu of taxes on state beach and park lands would provide for some increase in the cost of State Government. The slight increase in cost, however, would be offset by the advantages that would accrue in establishing the principle of payments in lieu of taxes and thus support the contention of this committee and the local units of government of this State that federal payments in lieu of taxes are essential to the stability of local government in areas where the Federal Government owns a substantial portion of the total amount of land. The general manager of the County Supervisors Association testified that one of the arguments used in opposition to federal in lieu payments was that the Federal Government was being asked to adopt a principle with respect to federal ownership which was not in effect with respect to state lands.

LOCAL PUBLIC LANDS

Representatives of three counties, Inyo, Mono, and Tuolumne, testified to a type of public land ownership problem which is increasing in some of the mountain

TABLE 2

PAYMENTS IN LIEU OF TAXES FOR SELECTED BEACH AND PARK LANDS BY COUNTIES

Item	Del Norte	El Dorado	Humboldt	Santa Cruz
1. Assessed Valuation Land 1954-55	$8,650,420	$11,421,670	$34,466,940	$37,579,260
2. 2% of Assessed Valuation Land 1954-55	177,008	228,434	689,338	751,586
3. Beaches and Parks Land Assessed Valuation 1955	1,290,425	1,182,950	1,939,610	1,405,000
4. Excess Item 3 over Item 2	1,113,417	954,516	1,250,272	653,414
5. Average Tax Rates Per $100 Assessed Valuation	6.59	4.43	7.48	5.35
6. In Lieu Tax	73,374	42,285	93,520	34,958

counties. This is land owned for water and power purposes by municipal corporations and irrigation districts located in other counties. This type of land ownership by local units is in addition to large areas in these counties in federal and state ownership.

The Los Angeles Department of Water and Power receives a part of its water supply from reservoirs on land owned in Inyo and Mono. The City of Los Angeles provides payments in lieu of taxes for the land based on the value at the time of acquisition. Structures and other improvements on the land, however, are tax exempt.

In Inyo County, only 1.5 percent of the total county area is in private ownership since over 6,000,000 of the 6,548,000 acres in the county is in federal and state ownership and 229,370 acres or 70 percent of the balance is owned by the Los Angeles Department of Water and Power. The city payments in lieu of taxes account for approximately 40 percent of the taxes collected in the county. The 30 percent of the land subject to taxes in private ownership pay 60 percent of the county taxes. The reason that the City of Los Angeles, owning 70 percent of the taxable land, pays only 40 percent of the total taxes, according to a witness representing Inyo and Mono Counties at the Los Angeles hearing of this committee October 25, 1956, is that the improvements that were once located on the land have either been destroyed or have deteriorated. This witness testified that at the time the City of Los Angeles acquired the farm lands in Inyo County there were hundreds of farm buildings, dwelling houses, barns, garages, and other improvements that have been destroyed or have just wasted away. Privately owned lands, however, have proceeded to develop with the net result that each year the taxes paid by the private owners is going up and the percentage of taxes paid by the City of Los Angeles is going down.

The representatives of Inyo and Mono Counties estimate that the City of Los Angeles has in excess of $200,000,000 in improvements in these two counties which are entirely tax exempt. These improvements require county and school services which have to be paid for by the taxes on the 1.5 percent of the total county land in private ownership. The City of Los Angeles, for example, houses its employees in tax exempt dwellings. The people who live in these dwellings demand the same services as other citizens. Their children go to school and receive the same treatment as other children in the community. The District Attorney of Inyo County stated that some of the schools in some of the school districts are incapable of operating because of insufficient revenue.

Testimony submitted by the Tuolumne County Assessor shows that the conditions existing in Inyo and Mono Counties are being duplicated in Tuolumne County. Federal and state-owned land account for 74 percent of the total land area of the county. The 364,416 acres of the total of 1,401,600 acres in the county classified according to use are as follows:

Use	*Acres*
Timber land	29,920
Grazing land	329,200
Mining land	185
Residential and commercial	1,920
Recreation (potential)	3,191
Total private land	364,416

The value of the privately owned land is on a declining curve since the timber is being harvested annually and is not on a sustained yield basis. The livestock industry has utilized the maximum amount of level available for grazing purposes and cannot expand. The Turlock Irrigation District and the Oakdale-South San Joaquin Irrigation District has purchased 6,469 of these grazing lands and thus removed them from the tax rolls. The construction of the Turlock Dam and the increase in the capacity of the Don Pedro Reservoir will remove several more thousand acres of grazing land from the tax rolls. Land and improvements owned by irrigation districts are not subject to taxation.

The City and County of San Francisco also owns lands in Tuolumne County for the storage of water and production of power. San Francisco, however, makes payments in lieu of taxes on its land and water rights assessed at $374,855. Improvements on the land owned by San Francisco in this county, like those owned by Los Angeles in Inyo and Mono Counties, are tax exempt.

The county assessor estimates that the value of the tax exempt properties of the municipal corporation and irrigation districts is $62,550,000 whereas the total assessed value of the county is less than $30,000,000. This is a ratio of the tax exempt property of two to one over that of tax exempt property now under construction and proposed future addition is estimated to be $178,945,000 or an expected total value of tax exempt property of $241,495,145. This would bring the ratio of tax exempt property to four to one over that of the taxable property in the county.

The assessor states that there are 66 dwelling units for employees on the three tax exempt properties and that the expanded facilities will increase the number of such exempt units for which county and school services must be provided by the $30,000,000 tax base which the assessor states cannot absorb the added cost of county government and schools.

This increase in the expansion of reservoir and power facilities by tax exempt irrigation districts and municipal corporations is cited as an example of the inroads made by tax exempt agencies of government in the counties of origin of water resources. The completion of the State Water Plan will increase the tax exempt facilities in such counties and increase the cost of governmental services.

Brushlands Need
Fire Protection to
Preserve Vital
Watershed Areas

A Surface Fire
Starting to Crown

CHAPTER 4

FIRE PROTECTION

Forest fire protection is a major activity of the U. S. Forest Service and the Division of Forestry of the California Department of Natural Resources. The Forest Service provides fire protection for the national forest areas including 5.5 million acres of privately owned land within the national forest boundaries.

The organization and fire protection functions of the Division of Forestry were described in the 1953 report of this committee on *Forestry Problems*. The past two decades have witnessed a number of improvements in the fire protection activities of this division. The 1940 fire plan represented the first organized program to provide what was considered to be adequate forest fire protection at that time. The increase in lumber production and more intensive use of the wildland area by the ever expanding population of California required a revision of the fire plan. This revision resulted in the 1950 fire plan. Continuous revision of the fire plan to meet changing conditions has been found to be necessary. The third revision of the fire plan requiring changes in the organization for fire protection is known as the 1956 fire plan.

THE 1940 FIRE PLAN

Prior to 1932, the initial attack on fires was made by local citizens and private protection agencies, augmented by such "pick-up" crews as could be mustered by public agencies. Many fires which could be quickly controlled today frequently developed into fires of considerable proportion as a result of the lack of organized and coordinated attack procedures. In 1932, a plan was developed by the State Forester to employ small mobile crews on a seasonal basis. This provided the first step for the development of an organized fire plan.

The two major results of the 1940 fire plan were: (1) reorganization of the principle that the forest values of timber, range, and watershed use, of general state-wide interest, should be segregated from all rural and structural values having only local value and interest; and (2) the development of a system of precise allotment of fire protection forces in accordance with need without regard to fund sources or local pressure demands. The result of the adoption of this fire plan was that the fire crew organization became an established support item in the budget and a definite fire season was established for budgeting purposes.

The 1940 fire plan provided the basis for the clarifying legislation of 1945 which sets forth the relative spheres of responsibility of the various levels of government, federal, state, and local. The Federal Government is: (1) entirely responsible for the protection of federal lands of every category; and (2) a financial contributor to the protection of private and state-owned lands having primary timber and watershed values.

The State has primary responsibility for the protection of nonfederal, unincorporated lands: (1) producing or capable of producing forest products (Zone 1); or (2) which might suffer excessive erosion or loss of water for irrigation, domestic, and industrial use (Zone 1); and (3) which are principally range lands contiguous to the above described lands. Local governments provide fire protection facilities in varying degrees decided by local conditions. Some counties have county-wide fire departments. Fire protection facilities for unincorporated areas in other counties are provided by special fire districts.

THE 1950 FIRE PLAN

The 1940 fire plan reached a peak of 220 fire suppression crews, 78 lookouts, and 12 patrolmen. The 1950 fire plan provided for an increase in the planned strength to 241 suppression crews, 85 lookouts, and 32 patrolmen. The new fire plan also enabled the Division of Forestry to make use of technological improvements in fire fighting equipment and practices. Radio equipped four-wheel drive crew trucks carrying several hundred gallons of water together with a high output pump and hose lines replaced the use of trucks equipped with back-pack pumps. Bulldozers for rapid line construction through dense cover were provided. The division also uses helicopters for rapid paying-out of hose lines in difficult terrain.

The committee which developed the 1950 fire plan made a number of suggestions for further improvements in the fire protection program of the Division of Forestry. Some of the most important of these recommendations were:

1. Year long employment of one foreman for each approved crew station and patrolmen position. This was regarded as essential to the maintenance of competent leadership for the seasonal fire crews.
2. Adequate relief for foremen, equipment, operators, and lookouts to compensate for the five-

day week and official holidays during the fire season.

3. One patrolman in each of the following districts: Honeydew area in southwest Humboldt County, Murphys-West Point area in Calaveras County, Kaweah area of Tulare County, and an additional assistant ranger position in Humboldt County.

THE 1956 FIRE PLAN

A summary of the 1956 fire plan approved by the State Board of Forestry, August 8, 1956 is as follows:

The operation of a fire protection system on suburban, rural and wildland areas of California is very complex because of intermingled types of areas and kinds of responsibilities (including intermingled forest and structural fire problems) and because of the intermingling of federal, state and privately owned lands. However, through contractual agreements and harmonious working relationships with the various local and governmental agencies concerned, a system has been developed which provides protection to the several areas of responsibility with a minimum of duplication of effort and expense. This system is briefly described in the following paragraphs. A number of details are omitted for the sake of brevity.

(a) Federal Responsibility Lands

The U. S. Forest Service, at federal expense, provides forest fire protection on federally-owned lands within the National forests. Some federal lands along the boundaries of the National Forests are contracted to the State for fire protection. Also, the State Forester contracts with the U. S. Forest Service for them to provide fire protection on 5,578,000 acres of "State responsibility" lands within the National Forests. (i.e., state and privately-owned timber and watershed lands.)

The National Park Service provides fire protection in the several National Parks and Monuments within the State.

The military agencies are responsible for fire protection as needed on military reservations.

Fire protection on other federally-owned timber and watershed lands, being intermingled with "state responsibility" lands, is generally provided by the State (in some instances by counties) under contract with the appropriate federal agency.

(b) Local Responsibility Lands

Outside of incorporated cities, on lands which have not been classified by law as timber, watershed or contiguous range lands, local agencies are responsible for fire protection. In some areas this protection is provided by local or county-wide fire districts; in other areas by county fire departments. However, in 30 counties the State Forester, at the request of the local government, contracts to provide this rural fire protection system at county or fire district expense.

(c) The areas in which the State has primary responsibility for maintaining the fire protection system are divided into three categories:

(1) **Areas in which the Division of Forestry provides fire protection directly.** This consists of 22,800,000 acres of timber, watershed, and range lands lying generally outside the boundaries of the national forests. It includes about two million acres of intermingled federal lands protected under contract with federal agencies. The division's organization for administering its activities in this area is divided into six districts with headquarters at Santa Rosa, Redding, North Sacramento, Fresno, Monterey, and Riverside. In these six districts are 30 ranger units through which is provided local administration and supervision of fire prevention and fire suppression activities, consisting of some 225 fire crews, 80 fire lookouts, fire prevention patrolmen, the operation of specialized fire fighting equipment and numerous citizen volunteer fire fighting groups. These consist of 5,578,000 acres, mostly of private lands. These lands are presently afforded fire protection by the U. S. Forest Service as noted in (a) above.

(2) **State responsibility lands in "contract" counties.** These consist of 3,209,000 acres of timber, watershed and range lands in six counties which have elected, as provided by law, to provide forest fire protection on state responsibility areas. These counties are Marin, San Mateo, Santa Barbara, Kern, Ventura and Los Angeles. The fire protection hereby afforded is integrated with a county-wide fire protection system in the rural areas of each county.

With the exception of Kern County, these counties had maintained forest fire protection system before the state system was well established. The Legislature annually appropriates funds to the State Forester for the support of the forest fire crew organization in these counties. This appropriation partially reimburses the counties concerned for the cost of fire protection in such state responsibility areas.

PROBLEMS AND SOLUTIONS

A. General

The state responsibility areas encompass about one-half the water producing land in California and one-half of its timber producing areas. Maintenance of a cover of timber and other vegetation on these areas is vital to the economy of the State because of

increasing values of the timber resource (the timber industry employs 10 percent of those engaged in manufacturing in California, second highest lumber production in the Nation), and because of the role played by vegetation in protecting streams and reservoirs from siltation with resultant pollution of water, reduction in storage capacity and cost of channel clearance, levee repairs, etc. While other factors of land use affect the result, protection from uncontrolled fire is a primary necessity. The average annual occurrence of fires on these lands exceeds 3,000 in number, which burn an average of 190,000 acres per year.

The objective of the State's Fire Plan is to provide basic fire protection to all areas of state responsibility.

"Basic fire protection," as defined for the purpose of this plan, is that level of intensity of fire protection which will, through the application of properly integrated fire prevention, presuppression and fire control efforts, hold the fire damage below the level at which it would seriously interfere with the expected yield of products and of social benefits from these lands.

"Basic fire protection" envisions an organization capable of reducing the occurrence of preventable fires to an acceptable minimum and providing satisfactory forest fire control (i.e. control during first burning period) under *average bad* fire danger conditions. It does not envision preventing all man-caused fires, nor providing absolute maximum fire protection with all possible refinements of fire control operations, but rather a basic organization supplemented by the planned use of available cooperative forces. Its strength comes not from having maximum forces in every area but in its ability to expand rapidly and from its state-wide flexibility of operation which enables it to successfully meet emergency fire situations.

Such an organization must have an adequate supervisory staff, a trained complement of crew leaders and equipment operators, mobility of personnel, adequate communications, fire control equipment, and transportation facilities to achieve the foregoing objectives.

In planning this basic fire protection organization, the Division of Forestry recognizes that population concentrations in mountain areas, intermingled with forest vegetation, have made the forest fire problem more complex by removing the advantages of selecting time and place of action in fire control operations. Therefore, the division plans to meet this more complex watershed, timber, and range fire problem through strengthened fire prevention, presuppression, and fire control means.

B. Areas of Direct Protection

In comparing the existing fire control organization (its administration and its crews with their complements of men and equipment) with the basic objectives of the 1956 fire plan, certain over-all problems presented themselves for solution. These were:

1. **An insufficient number of fully trained crew leaders and equipment operating personnel** to realize the maximum efficiency from the manpower and equipment in the initial attack units, not only in fire control but in fire prevention and presuppression operations. Seasonal employment problems plus budget deficiencies have caused this problem.

2. **Weakness in the existing initial attack crew strength, due to a lack of firefighter personnel.** This is largely due to failure to compensate budgetarily for the 40-hour week.

   By establishing five different crew complements from which the field administrator might choose to meet the fire problem in any specific area the division plans to meet problem 1 and 2. Embodied in each crew complement is a foreman on the job seven days a week (three foremen hired for each two stations); one truck-driver employed to man each forest fire truck; and all firefighters in the crew complement to be employed during the fire season peak. In addition, cooks are planned for the larger crew complements with two cooks for ranger unit headquarters stations.

   The planned fire crew standards differ from the previous standards (adopted in 1940) principally in the effective (firegoing) strength at any given date at the peak of the season. In comparison, the largest crew under the old concept included 13 men which, excluding the cook, meant 12 firegoers were planned to be on the job at any given day at the peak of the season. This plan was evolved when a seven-day work week was normal.

   The largest crew in the proposed allocation, while employing $14\frac{1}{2}$ men, would actually have only nine effective men on the job daily because of the present days-off requirement. This slight decrease in total effective strength of a given crew should be offset by the higher caliber of supervisors obtained through tenure and training.

   The planned crews would have one foreman at all times but a driver only five days a week for each truck. By working drivers seven days a week when fire conditions require it and by having the foreman available to drive one of the trucks part of the time at all two-truck stations, all trucks can be manned and all supervisory positions can be effective when fire conditions require, which is not the case now as may be readily seen in Table 2. Compensating time off would be given at the end of the season in the case of the seasonal driver and in the winter for the permanent foreman and driver.

In order to retain a nucleus of trained men, to enable hiring of a higher caliber man, and for a resultant increase in the efficiency of the crew unit, it was deemed necessary to retain all foremen year-long and to retain year-long one forest fire truck driver for each crew unit. Furthermore, employment conditions generally, required skills, and CDF conditions of work, make such staffing necessary under present day conditions. Staffing patterns for large bulldozers were set at three forestry equipment operators year-long and for medium bulldozers, two forestry equipment operators year-long, to provide adequate relief and sufficient operators for the bulldozer-transport units and auxiliary servicing equipment.

3. **Lack of initial attack striking forces in some areas.** In a few areas the intensity of protection is not commensurate with the fire problem and potential losses. Seven new crews and 23 medium bulldozer transport units are proposed.

4. **Insufficient equipment to service Division of Forestry and hired bulldozers and other equipment on large fires.** Unserviced equipment on a fire is worse than none, for its use is planned and its failure to perform may mean loss of the fire.

   (1) 32 bulldozer service and pilot vehicles are proposed.

5. **General lack of auxiliary equipment to facilitate the job of fire management.** The Division of Forestry has been unable to keep up with modern developments in backfiring equipment, field kitchens, etc. There is a need for water tankers to refill firetrucks and other miscellaneous pieces of fire equipment. Prohibitive cost will be avoided in the 28 proposed dumptruck tankers by using canvas tanks devised by Division personnel and proven to be satisfactory. One forest firetruck driver year-long is planned for water supply trucks where there units were proposed because of the need for a skilled man to drive such an unstable load. In addition to the dumptruck tankers, 15 pieces of miscellaneous fire equipment are proposed.

6. **Insufficient field personnel and their equipment to meet the local fire prevention workload.** As more people enter and more activities occur in wild land areas the "on-the-ground" fire prevention problem increases. Ten patrolmen are proposed for isolated areas where there are insufficient number of assistant rangers who cannot cover the areas and for populous areas. Forty-nine (49) pickup pumpers are proposed for use by fire crew station foreman to do local fire prevention work while on radio contact.

7. **Understaffing in ranger unit headquarters in functions of dispatching, warehousing, and clerical services.** For a number of years the division has had to "borrow" from its fire control forces to bolster these essential activities and has had to work personnel for too many hours without rest during fire periods. Only one dispatcher per ranger unit is provided now to maintain 24-hour service and no service of supply personnel at all. Forty-three (43) foremen, as assistant dispatchers and/or warehousemen, and 24 clerks and miscellaneous personnel are proposed.

8. **Insufficient staff in the State Forester's Office.** The State Forester's staff, which has always been small in comparison to the size of the organization, is presently working to maximum capacity and is unable to fully discharge its duties in an adequate manner. The principal need is for staff officers at the secondary and intermediate levels. They would keep operations current, do or supervise staff research and thus allow principal staff officers time to analyze major problems, participate in policy development, attend vitally needed field conferences and make field inspections.

   The addition of two Assistant Deputy State Foresters and three rangers is proposed to accomplish this purpose. For the staff as a whole, 68 people are now authorized and 10 additional are proposed.

9. **Insufficient general staff at district headquarters.** At the six district headquarters workload conditions comparable to those at the State Forester's Office have built up as programs expanded and size of organization to be supervised increased without commensurate increases in staff. A ranger at each district headquarters to provide better coordination of fire control, equipment, communications and honor camp programs (up to four camps) is proposed. One junior civil engineer per district to assist the existing engineer in surveys and rights of way processing on the 5,500 miles of roads and telephones and the more than 300 station sites maintained by the division is proposed. Five mechanic-foremen to perform or provide technical guidance for inspection and repair of the division's 1,800 pieces of motorized equipment is proposed for addition to the present staff of 13. In all, 35 additional facilitating personnel are planned for the six districts.

10. **Insufficient special training personnel to provide an adequate training program.** The division has a training officer and a reasonably good in-service training program. However, fire equipment is becoming increasingly complex and new

fire control techniques are being developed rapidly. The value of the resource protected is rapidly increasing and, with complications caused by influx of people and structures into forest areas, the need for more intensive and efficient fire control and prevention operations is becoming apparent. To supplement the normal in-service training there is need for a more formal and comprehensive program to insure that fire control personnel will receive the same fundamental training in techniques of accomplishing their complex job. This proposal is in line with practice in other large fire departments, and in industry. The establishment of a training center in each of the six districts is proposed. Staffing would require a total of six rangers, six associate rangers, six cooks, and six assistant cooks. Activation of the program would start with two training centers and be implemented over a period of years.

11. **Insufficient staff to plan and coordinate the fire prevention program.** Little change in staffing has been made in this function since 1943, although the program has been strongly emphasized by efforts of all the division's personnel. The increasing population (necessitating a stepped-up public education program) plus the great need to make a detailed fire prevention and law enforcement analysis and investigation of each fire requires study, analysis and coordination beyond the abilities and capabilities of the operating staff at the district and Sacramento levels (nine men now provided for the program). The addition of a law enforcement supervisor and a fire prevention assistant on the State Forester's staff and of nine fire prevention assistants to the district staffs is proposed.

12. **Insufficient funds to maintain an adequate program of fire control equipment development and research.** Utilizing part of the time of its three equipment engineers and regular administrative personnel, the division has managed to do remarkably well at keeping abreast of developments in fire control equipment and techniques. It has cooperated well with other agencies and contributed significantly to numerous new programs. However, at the present time the division has only $10,000 available for research (being used to assist in the development of a fire risk index) and must use operating funds for its limited equipment development program. Progress in achieving satisfactory fire control will come only from constant search for better ways to do the job.

    A $100,000 program involving cooperation with other research and fire agencies in the adaptation of new equipment (aircraft, tanks, chemicals, etc.) and development of new techniques for the fire control job by the division's own operating personnel in the field, is proposed. One ranger to administer this program is proposed.

13. **Insufficient personnel in the Forestry Honor Camp Program to provide adequate crew supervision, equipment operation, and clerical service.** This program, in accordance with legislative policy, is expanding at the rate of two honor camps (160 inmates) each year. Honor camp inmates provide an invaluable reservoir of trained crews to follow up initial attack crews in fire control operations. They also do much maintenance of fire control facilities and fire hazard reduction work.

    Lack of crew foremen necessitates using crews rather ineffectively, especially on the fire line (20 men per foreman). Lack of any equipment operators at some camps makes use of existing bulldozer difficult. An operator per 'dozer and foreman to allow about 15-man crews on the job is proposed. Total of 21 foremen, four 'dozer operators, three clerks and four bulldozer transports are proposed in this program.

C. *Proposed Plan for the Protection of Private Lands Within the Protective Boundaries of the National Forests*

The State of California presently contracts fire protection for the 5,578,000 acres of private lands within the national forests to the United States Forest Service. Payment for this protection is made to the forest service based upon 65 percent of their 1951 protection costs within each national forest for each control zone. This does not consider the intensity of fire protection which the State may be providing to similar lands located outside the national forests and under the direct protection of the State Division of Forestry.

A plan for adequate protection must provide statewide for all private lands an equivalent level of fire protection for similar lands similarly located and of comparable fire problem. Those private lands within the national forests deserve the same intensity of fire protection as those adjacent comparable private lands which are directly protected by the State Division of Forestry.

To meet the state responsibility to these lands, the division proposes a three-point plan:

1. That wherever existing state crews can expand their initial attack area to encompass blocks of private land presently under federal protection, the protection boundaries be revised to include these lands as soon as possible.

2. Because of the complexity of the problem, the division plans to assume direct protection of larger blocks of predominantly private land wherever and whenever its organization can reasonably be staffed and equipped to do so. This would be the case where such blocks were contiguous or near to existing state ranger units, or where they were of sufficiently large size to set up an efficient fire control unit which could be backed up within a reasonable time from the nearest state ranger unit. The implementation of this plan would be based upon an orderly timetable and dependent upon approval of budget requests for additional facilities.

3. For those areas under present forest service contractual protection the division has determined the fire control forces (crews, lookouts, and patrolmen) which the State would have available for similar areas in comparable ranger units. It is planned to budget for the national forest private land areas, similar staffing and crew units to that planned for the comparable Division of Forestry direct protection area. Such fire control forces would be specifically located, in cooperation with the forest service, and in conjunction with their fire control forces, to best apply to the private land fire problem. The crew units would be solely supported by the State and reasonably restricted in used and area so as to be readily available for the private land protection job in that general area. Pending transfer of protection responsibility for the large blocks of private land, the U. S. Forest Service fire control units supported by state appropriations, are included within this plan.

A proposed allotment of crews, lookouts and patrolmen has been made, based upon the organization planned for adjacent state ranger units or contract counties. This is a tentative plan based upon this formula and is subject to some changes in specific numbers of crews within each forest after a proposed on-the-ground review of forest by forest of the private land fire problem and the specific location of the individual fire control units to best meet this problem. However, this should not result in any material change in total number of units or cost.

The plan calls for 62 crews, 21 lookouts, and 19 patrolmen at a total annual cost of approximately $1,444,000. Present allocation is $782,000 which, however, is recognized as being much less than cost. The U. S. Forest Service has requested the State to relieve them of the burden of additional cost.

D. State Responsibility Land in Contract Counties

The third component of the plan deals with state responsibility lands within counties that operate their own county-wide fire protection organizations. The goal was to develop a plan which would reflect the organization necessary to provide basic protection and to determine the cost thereof.

The following are contract counties and number of acres of state responsibility lands within these counties:

Kern County	1,355,200 acres
Los Angeles County	520,140 acres
Marin County	247,800 acres
San Mateo County	182,160 acres
Santa Barbara County	571,040 acres
Ventura County	333,580 acres
Total gross	3,209,920 acres

A comparison of organization presently financed by the State and the proposal to provide basic protection follows:

Present crew complement	*Proposed crew complement*
4—4-man crews	58—No. 1 crews (1 truck, 1 foreman, 1 driver, 3 firefighters)
33—9-man crews	9—No. 3 crews (2 trucks, 1 foreman, 2 drivers, 6 firefighters)
12—lookouts	2—No. 5 crews (2 trucks, 1 foreman, 2 drivers, 10 firefighters)
7—bulldozer-transport units	5—large bulldozer-transport units
	5—medium bulldozer-transport units
	12—lookouts
	6—nurse tankers

CONTRACT COUNTIES

1956 Fire Plan

DETAIL OF ANNUAL COSTS

(Thousands of Dollars)

	Present	*Proposed*	*Difference*	*Percent Difference*
Kern	$254	$400	$146	58
Los Angeles	325	591	266	82
Marin	81	123	42	52
San Mateo	84	112	28	33
Santa Barbara	115	203	88	76
Ventura	117	219	102	87
Total	$976	$1,648	$672	69

CHAPTER 5

REGULATION OF FOREST PRACTICES

Approximately half of the commercial forest land in California is federally owned and the other half is in private ownership. The importance of the production of forest products in the economy of the State requires the use of sound forest practices in both areas of public and private ownership of the forest lands. As discussed in the 1953 report of this committee, *Forestry Problems*, the establishment of sound forest practices is not particularly difficult when such practices are applicable to forest areas owned by the government. An entirely different problem is presented when such regulations are applicable to privately owned lands.

The California Forest Practice Act of 1945 was enacted as a result of the findings of the California Forest Study Committee which summarized the forest problem in California as follows:

1. The cutting of old growth in such a way as to maintain productivity of forest land and the prolongation of the life of the old-growth supplies.
2. The reforestation of as much as possible of that part of the worst area of cut-over lands that seems reasonably certain of favorable response to planting or seeding.
3. The reduction of losses by forest fires, both in old-growth timber and second growth, and of further damage by fire to the growing capacity of nonreforested cut-over lands.
4. The reduction of losses by insects and disease.
5. The providing for a continuity of state forest policy.

The Forest Practice Act is directed toward the solution of these problems based upon a cooperative approach in the regulation of private forest cutting practices. The State Forester reported at the Sacramento hearing of this committee, July 13 and 14, 1956, that the Forest Practice Act, as now constituted, expresses the policy of the Legislature in regard to maintaining the productivity of private forest lands. It authorizes the regulation of timber harvesting by means of rules promulgated by four forest practice committees whose membership includes representatives of segments of the timber industry owning and operating industry. Such rules are then approved by a vote of the timber ownership and adopted by the State Board of Forestry after hearings and publication. Provision is made for amendment of the rules upon petition of 50 percent or more of the timberland ownership of any forest district or upon recommendation of the State Forester to the State Board of Forestry. Rule amendments are then developed by the forest practice committees with public hearings conducted by them, followed by notice, adoption, and publication by the board. Alternate forest management plans of any timber owner, when approved by forest practice committees and the board may be substituted for the district rules when they meet the requirements or improve upon the objectives of these rules.

The forest practice committees have been established for each of the four forest districts as follows: Redwood Forest Practice Committee; North Sierra Pine Forest Practice Committee; South Sierra Pine Forest Practice Committee; and the Coast Range Pine and Fir Forest Practice Committee. The administration of the forest practice rules by the Division of Forestry of the Department of Natural Resources has added regulatory activities to the fire protection functions previously assigned to this agency as discussed in the preceding chapter of this report.

The Forest Practice Act has now been in effective operation for approximately 10 years inasmuch as the first forest practice rules were adopted under the established voting procedure in 1947. The State Forester reports that this act was the first real venture in statutory control of timber harvesting based upon the principle of self-regulation by participation of the industry in establishing legal rules of conduct. Some amendments have been made to the act since its enactment in 1945. Some of the most important of these amendments were the requirements for possession of a timber operator's permit, the violation of which is a misdemeanor, and the provision for suspension and revocation of such permits upon showing of violation of the forest practice rules.

The State Forester also reports that, although there has been substantially good compliance with the forest practice rules by timber operators, there have been enough violations in recent years to prompt the majority of the timber industry, the forest practice committees, and others to question whether or not enforcement procedures were sufficiently strong to compel compliance with the act. It is believed by many that more effective measures should be taken to stop the destructive practices being employed by certain operators who have continuously and flagrantly violated the laws.

Several major changes in the forest industries have occurred since the enactment of the Forest Practice Act in 1945. There has been a substantial increase in the production of timber, the number of registered timber operators, timber operations, and sawmills from 1945 to 1955 as follows:

Timber operations	*1945*	*1955*
Timber production—billion bd. ft.	2.2	5.6
Registered timber operators	299	1,768
Number of timber operators	1,171	1,828
Sawmills	400	1,300

Prior to 1945 most timber operations were conducted by persons or organizations who owned both the timber and the timberland. These owner-operators owned and operated their own logging shows, transportation facilities, and sawmills. Little logging activity took place on timber owned by nonoperators or upon timber in small ownerships which represents about one-half of the privately owned timber in the State.

Operations have now increased upon all of these timberlands. Timber on approximately 10,000 parcels of land in small ownerships is eagerly sought by the operators. This timber includes about 30 billion board feet in tracts owned by farmers and ranchers. Logging contractors—gypos—hardly existed 10 years ago but are now prevalent in the log market and are also used by large owner-operators to do their logging.

Progress in forest management and in forest practices has taken place. Individual companies have developed management programs with forest practice standards set much higher than those required by law. The industry-sponsored tree farm program has accelerated the acceptance of timberland management and protection for the production of continuous yield of tree crops by both large and small ownerships. Industry now employs about 370 professional foresters in California. An increased number of private consulting foresters are also contributing to improved forestry practices on both large and small timberland ownerships.

PROPOSED AMENDMENTS

In spite of these advances in improved forest practices, there are an increasing number of flagrant law violations which result in substantial reduction of forest land productivity and in addition, increase the risk of timber destruction on neighboring properties from fire and forest pests. The administrative difficulties encountered in the enforcement of the forest practice rules have continued to be a major problem.

Recommendations for amendments to alleviate some of the administrative problems have been reviewed by industry representatives, the forest practice committees, and the State Board of Forestry. Approved recommendations for amendments to the Forest Practice Act are as follows:

1. Name the act and authorize its citation as "The Forest Practice Act."
2. Clarify certain language and obtain uniformity in technical terms.
3. Authorize the State Forester to enter and inspect lands.
4. Define the boundaries of forest districts more clearly and authorize the Board of Forestry to fix the eastern edge of Redwood Forest District along the natural occurrence of redwood.
5. Clarify language for formulation of rules.
6. Authorize use of certified mail as well as registered mail in transmission of legal papers, and include personal service for this purpose.
7. Clarify and modify the method of hearing and publication on formulation of rules by committee.
8. Permit timber operators, with consent of owner, to obtain alternate plans.
9. Place responsibility for compliance with rules and plans upon the timber operator, but exempt only compliance with seed tree and diameter limits where land is to be converted to other than timber growing use.
10. Make the Forest Practice Act exclusive regulation for timber operations.
11. Validate existing Forest Practice Rules.
12. Provide for revocation and repeal of rules, under express conditions, by the Board of Forestry.
13. Extend statute making it a misdemeanor to operate without a permit to include persons who conspire with another to engage in timber operations.
14. Repeal all of Article 4 and add a new Article 4, under title: Permits.
15. Require applications for permits and specify information to be given.
16. Require annual notice of operating locations, and prescribe conditions for notice when annual notice cannot be given.
17. Require nonresident applicant to designate a resident agent for service of notice of timber operations.
18. Authorize a continuous permit, subject to cancellation for failure to give notice of timber operations.
19. Authorize State Forester to deny permits under express conditions.
20. Provide technical legal description of the permit, its use, purposes, validity, etc.
21. Provide grounds for suspension and revocation of permits.
22. Establish statute of limitations for commencement of actions.
23. Retain provision for notice of violation and reasonable time to comply before action is commenced to suspend or revoke a permit.
24. Provide method of suspension and revocation and include special provisions for remission of order by the director in the nature of a reinstatement where a new set of facts or change of circumstances can be shown. Limit suspension or revocation to one year, after which the applicant would have an absolute right to reinstatement.

CHAPTER 6

FOREST INDUSTRIES

The fire protection and forest practice management activities of the Division of Forestry, discussed in the two preceding chapters, are necessary for the preservation and development of the resources of the State. Some of the earlier investigations of this committee have shown the possibilities of further development of the forest industries in this State. The development and growth of new wood fiber and pulp industries would provide for greater utilization of the forest yield. The expansion of such industries would also add stability to the timber industry and benefit the entire economy of the State.

The data presented in the preceding chapter of this report show that the production of timber has increased from 2.2 billion board feet in 1945 to 5.6 billion board feet in 1955. The continued prosperity of the timber industry depends upon the demand for forest products. This demand in turn depends upon the state of the economy and the relative demand for competitive products. The economic outlook for the forest product industries from 1956 to 1960 was presented at the Sierra Cascade Logging Conference in Sacramento, February 14, 1957, by Dr. A. Kenneth Beggs, Stanford Research Institute. Dr. Beggs stated that the large growth in consumption of forest products generally has been a strong, healthy, and growing national economy and there seem to be no impediments in the way of the whole economy continuing its upward movement toward higher and higher levels of activity.

Although this forecast of continued growth in the national economy is encouraging, the studies of the Stanford Research Institute also show that there are economic warning signs of considerable interest to the forest industries in California. One of these is the increased cost of timber production. Since the most important market for lumber is its use in residential construction, any decline in the demand for lumber for this purpose has serious consequences for the timber industry. Studies conducted by the Stanford Research Institute show that about 47 percent of the dwelling market for lumber has been lost in the last 35 years. About 12 percent of this loss of market has been to other forest products. The rest of this loss is to the products of other industries, such as structural clay products, aluminum, steel, gypsum board, and other products.

On the other hand, Dr. Beggs told the members of the Sierra Cascade Logging Conference that wood pulp, paper and paperboard do not face any such bleak prospects which appear to confront the timber industry. Dr. Beggs stated that:

> "Factors underlying the production of pulp, paper and board are such that large increases in production can be met with the prices of pulp, paper and board maintaining about the same relationship to the prices of their competing materials that they have in the past. The factors that appear to substantiate this bill are (1) the nature of the pulping process which permits the economical use of small size timber and forest residues, (2) the widespread availability of mill and forest residues for pulping —and at reasonably low cost; and (3) continuous improvements in pulping processes that permit use of even wider ranges of wood species for a wider range of paper and board without economic penalty. * * *
>
> "Because of the large timber resources of the West as compared to other regions and the economic advantage of the sawmills in the West compared to those in other regions, due both to their size and fuller utilization of the log, we expect the West to continue to increase its share of the total national lumber market, whatever its total size.
>
> "In terms of wood pulp, paper and board production, there is wide opportunity for continued expansion of the industry in the West in nearly all grades. This opportunity beckons because of the increasing size of the western market which is now being served by both regional production and significant amounts of imports from other regions. There are adequate timber resources and economic mill sites to support large increases in the regional output of pulp not only to supply the regional requirements, but to serve as a basis for exports to other regions of the Nation less endowed with timber and sites than the West.
>
> "The relative advantage of the West in terms of wood available for pulping arises partially because of our large stands of timber, but also because our large scale integrated forest products mills make the use of mill residuals more economically feasible than in other regions. We expect that in the next few years the West will account for about 20 percent of the total pulpwood consumed in the Nation as compared to about 18 percent at present. Further, we expect that almost half of this pulpwood will be in the form of mill residuals generated by the lumber and plywood industries. It is reason-

A California
Pulp and Paper
Mill

Some of the
Products of
California's
Paper Industry

able to conclude on this basis that the West will in the future increase its share of the Nation's wood pulp produced for conversion into paper and board and other products.

"This growth in pulp production in the West will be the natural outgrowth of the inevitable wedding of lumber, plywood, and pulp production throughout the forest product industries of the West. This union will, in part, relieve the pressure for higher and higher prices for lumber and plywood, and thus contribute toward insuring the continued prosperity of the forest products industries."

The relationship between fiber markets and better forest practices was discussed in the 1953 report of this committee on forestry problems. The discussion included in that report took note of the obstacles such as the problems of industrial development and water pollution that needed to be solved and cited the remarks of Henry Vaux of the School of Forestry, University of California.

"Expansion in the California wood fiber industry will not, however, come about automatically as a result of the existence here of the necessary potential demand and supplies. Substantial problems of industrial development must first be solved. These problems involve broad and complicated questions of economic and industrial growth. It is precisely because the problems lie outside of forestry and yet are vital to it that I feel this matter deserves your (this committee) attention. One group of basic obstacles to expansion to our wood fiber market lies in some everyday problems of business organization and development, such as the level and structure of transportation rates, labor and capital costs as compared with those of competing regions, problems of industrial water supply and effects of tax policies both on the establishment of new industries and on the feasibility of forestry.

* * *

"The second set of obstacles is primarily technological. Under currently used methods of pulp manufacture, tremendous quantities of pure water are required. For a bleach craft mill making a hundred tons of pulp per day, about the smallest practical size, forest products laboratory estimates that 6,000,000 gallons of processing water are needed to operate for one day. In the north coastal area of the State, I am told that water is now available to meet requirements of this magnitude for a pulp industry. But the bulk of our forest area lies in areas where water is scarce. Moreover, wood is expensive to haul over long distances; so plants fairly near the woods and hence where water supplies are not a potential or actual problem, will be needed if the available wood is to be marketed economically. The role of water supplies may thus be critical in determining the extent to which effective fiber markets can be developed in California.

"On the one hand is the problem of water pollution. Much study has already been given to this matter and some solutions have been found; but each new or prospective pulp plant must still face pollution as a major problem. A separate and unsolved question is how to utilize fiber without such heavy consumptive use of water. Purification of effluence to avoid pollution may also permit reuse of much of the processing water, but this, in turn, is costly and may be less economic than to locate where water is cheap and plentiful.

"It is thus apparent that there is plenty of room for developing fiber using methods which will be more economical in their use of water. But if this is to be achieved, a substantial program of research into how this may best be done seems clearly needed. The pulpwood paper industry is justly famous for the advanced level and technical ingenuity of its research program. Public agencies have also made splendid contributions to improve pulpwood paper technology, but so far as I can learn, only a small amount of research is now directed specifically at reusing water. Undoubtedly the problem is of much greater significance in California than anywhere else in the county. So this is a specific research problem where we, in California, need to assume the leadership and where successful development of new techniques can contribute significantly to more effective use of our timber resources."

The water pollution problems cited above were dramatically emphasized about two years ago when a cellophane plant proposed to locate in the upper Sacramento Valley. The industrial firm proposing this installation requested the regional water pollution control for a statement of discharge requirements in order to determine the degree of waste treatment that would be necessary. The actual facts, as subsequently developed, showed that the proposed wastes, even if discharged without treatment, would have caused no significant change in water quality after mixing and that complete protection would have been afforded downstream water users.

The atmosphere surrounding the hearings conducted by the water pollution control board, however, was so enmeshed in intense fear that the Sacramento River would reach a state of pollution comparable to some other sections of the country where water quality was not controlled that the public agencies represented at these hearings had difficulty in confining their deliberations to objective data. Feelings ran so high that after the hearings were concluded, the industrial firm decided not to locate in California.

The cellophane plant case provides a good example of how to discourage the needed expansion of auxiliary forest industries to realize the full utilization of forest products. The question which naturally arises from this case is "Will each proposal from the industry be accompanied by the hue and cry which surrounded the cellophane plant?"

The cellophane plant case also provides the basis for a negative answer to the above question. Testimony presented at the Sacramento hearing of this committee July 13 and 14, 1956, suggested the need for assembly and coordination of complete factual information which would facilitate the development and expansion of wood fiber industries in California. This need was emphasized by Paul W. Stathem, Forest Supervisor, Shasta-Trinity National Forest, who stated that forest supervisors, people in forest industries, and private land owners have repeated requests for information concerning the availability of raw material for the manufacture of forest products. The Director of Natural Resources stated that California is destined to experience considerable growth in a new and valuable industry because of its forest resources. It has been estimated that the wood residue (or waste) in this State from sawmills alone could supply raw material for 10 additional wood pulp mills of 250-ton-per-day capacity. To this could be added the residue left in the forest after logging operations and standing timber which is particularly suitable for pulping. California now ranks twenty-third in wood pulp manufacture whereas it ranks second in timber resources.

SURVEY OF WATER QUALITY REQUIREMENTS

The first step toward the encouragement of location of new wood fiber processing plants in California and avoidance of such situations as those resulting from the cellophane plant case was the organization of a cooperative study on waste treatment and disposal aspects of development of pulp and paper resources in California. This study was sponsored by the State Water Pollution Control Board to provide some of the answers to the pulp and paper industry question in advance of future inquiries and proposals from members of the wood fiber industries. Cooperating agencies and organizations are the State Division of Forestry, California Forest and Range Experiment Station, National Council for Stream Improvement, State Department of Water Resources, Water Pollution Control Boards, and the University of California.

The principal objectives of this cooperative study are as follows:

1. To determine the relationship of water quality and pollution control problems to the pulp and paper mill potentialities in California.
2. In order to make the above determinations, to obtain basic data on fiber resources, pulp and paper mill potentialities, millsite requirements including water supply, wastes produced after necessary treatment, and waste assimilative capacity of receiving waters.
3. To present factual data and to draw general conclusions therefrom in areas of probable development even though changes in water development and use (including that of other industries) might occur which might alter the conclusions.
4. To enunciate clearly that the regional water pollution control board will prescribe specific requirements for individual discharges of waste in light of existing and foreseeable conditions.

This study has been under way since June, 1956, and is now in the process of completion. One of the major problems of this study is that of estimating the quantity and characteristics of wastes which might be discharged from pulp mills. Some phases of this problem are being explored by the National Council for Stream Improvement. The regional water pollution control boards are determining the beneficial uses of receiving waters which are to be protected and the water quality requirement necessary to protect such uses. The water quality conditions to be maintained when related to the present water quality will give the waste assimilation capacity of the receiving waters. The waste assimilative capacity when related to the quantity and characteristics of the wastes anticipated will indicate whether the pulp potential estimated in the study can be realized without fear of polluting waters.

PROPOSED WOOD RESIDUE SURVEY

A survey made by the California Forest and Range Experiment Station in 1952 indicated that approximately 330,000,000 cubic feet of all kinds of wood residues are produced and go unused each year. Logging operations destroy or leave some material such as rough or short logs, tops, or damaged trees. The manufacture of lumber and other primitive wood products results in a large volume of residues—slabs, edgings, trimmings, sawdust, shavings, and other material. Veneer plants also turn out veneer clippings and veneer cores. Coarse residues suitable for use by fiber industries accounted for 242,000,000 cubic feet in 1951. Of this amount, 80,000,000 cubic feet was utilized primarily as fuel. The other 162,000,000 cubic feet of coarse material was burned as waste. This is a loss in wood products equivalent to the annual net growth on 4,800,0000 acres of California timber producing lands.

The State Forester states that not all of this residue can be used economically. Some is produced in plants with too low volume, or too isolated to pay the cost

of collecting and transporting the wood to fiber industries. Most of the unused wood, however, is concentrated in Northern California and is strategically located to encourage development of new residue-using industries.

The report of the 1952 survey may not reflect the current situation. The State Forester reports that during 1956, the University of California Forest Products Laboratory studied the need for making a current inventory of wood residues in the State at the request of the Laboratory Advisory Council composed of representatives of the wood using industries. Such an inventory would have the objective of reporting the location, quantity, and quality of wood residues.

This information would have to be collected, analyzed, and reported in considerably more detail than that of previous surveys in order to provide maximum utility to all possible users thereof. The proposed survey would be similar to those made and in progress in Washington and Oregon. Those who might profitably utilize this information include: (1) existing industries in search of additional local material for present or new products; and (2) new processing industries in search of raw materials available as residues.

Preliminary cost figures for this proposed survey are as follows:

Logging residue sample	$14,250
Milling residue sample	21,600
Analysis	14,340
Administration	10,038
Total cost	$60,228

According to the State Forester, the proposed survey would be accompanied by cooperation of all agencies concerned such as the University of California Forest Products Laboratory, The California Forest and Range Experiment Station, and the Division of Forestry. The proposed project is still under study by the laboratory and its advisory council. When the survey plans are completed, the project and methods of financing will be explored further with the State Board of Forestry, other organizations, and representatives of forest industries.

CHAPTER 7

FOREST AND WATER—A DUAL CROP

The relationship of forest and watershed lands becomes more important as the State Water Plan is perfected and construction starts on some of the major projects included in that plan. As stated in the 1953 report of this committee, the watershed areas represent important and neglected resources of California. Large areas of public domain and forest land are set aside for power site developments or other uses related to water supply, yet nothing is done with relation to watershed management.

The 1953 report of this committee also stated that the unexplored problem of watershed management requires two types of research: (1) research into ways and means of enhancing the water resources through forest practices; and (2) a survey of watershed conditions in all parts of the State as a basis for policy and program determination. No agency had any plans or organization for such research at that time.

The need for watershed management programs was again investigated by this committee at its hearing in Sacramento, July 13 and 14, 1956. Testimony submitted at this hearing not only supported the earlier findings of this committee of the need for developing such programs but stressed the paramount importance of starting such programs immediately. The State Forester, for example, stated that "California needs a strong program of watershed management research. With such a program, government and private landowners can learn how to manage lands in the various water yielding areas of the State to reduce floods and the sedimentation load of streams, to increase the yield of useable water, and to deliver water downstream in ways and at times conducive to its most efficient use. *In my opinion, California cannot maintain indefinitely the effectiveness of any water conservation plan it adopts without initiating now a comprehensive program of watershed management, study, and research.*"

The State Water Plan is based on past records of stream flow from mountain and foothill lands which produce some 70,000,000 acre-feet of water runoff in an average year. The Assistant State Engineer recently stated that although the Water Plan is feasible from an engineering standpoint, there are many pertinent questions directly related to watershed management which remain unanswered. One of these questions is "How can the basic stream flow be maintained or improved?"

Fire, logging, and grazing are three important aspects of watershed management. The State Division of Forestry maintains a forest and watershed fire protection program. This program of fire protection together with the administration of the Forest Practice Act involve some of the problems of watershed management. Other aspects are road building, production of hydroelectric power, mining, and recreation. The effect of these uses and land management practices need to be evaluated in terms of watershed management problems. The State Forester testified that:

> "We must know the effect of fire, of logging, grazing, and the other land management practices, watershed by watershed, on the quantity, quality and timing of water yields. We must determine and evaluate the present and future relationships of watersheds and watershed management and protection practices to our State's economic structure. We must give attention to areas where watershed conditions have deteriorated because of past use or misuse and where, as a consequence, remedial measures are needed. Strategic watershed areas should be delineated and managed mainly for water yield because of the critical relations that exist between them and the lands downstream. Preparatory to this, watershed management practices and experiences should be evaluated so that the application of recommended practices to particular situations in California could be made clear."

The three major objectives of watershed management research, according to a statement by the California Forest and Range Experiment Station, are to find out how to maintain, repair, and improve conditions which affect water flow and water quality. As we harvest the forest, some of the damages which might result can be avoided, thus maintaining the favorable conditions for water yield provided by unbroken plant cover. Research is also needed to learn the best methods of repair of damage resulting from fire or improvident land use. Water yield improvements requires a knowledge of methods of (1) reducing erosion so as to reduce the sediment load of streams, (2) reducing evaporative losses from watersheds so that more water will be released as downstream flow, and (3) delaying the melt of snow in the high mountain areas.

Some of the research necessary to develop methods of accomplishing these objectives has been conducted by the California Forest and Range Experiment Station in cooperation with other agencies.

In the brush-covered watersheds of Southern California, research is aimed at developing methods of

increasing the yield of water, slowing the movement of sediments from steep, unstable mountain slopes, and reducing floods and sedimentation by emergency treatment of burned areas.

In the high elevation snow zone of the Sierra Nevada, research is being conducted with the cooperation of the State Department of Water Resources. A five-year program of research in snow management began in 1956. Research in this snow zone is aimed at finding ways that the forests can be cut and other land managed to increase the accumulation of snow and delay the melt of snow. Thus, when these forests are cut for timber, it can be done in such a way that total water yield may be increased and summer flow prolonged.

In other areas of the State, watershed management research is hardly begun, yet some 40 percent of the State's water yield comes from these areas. There, intensified research is needed if methods are to be found to make the best use of the dual copy of forest products and water from California forest lands.

SOIL VEGETATION SURVEY

Another research project which provides useful information for watershed management is the inventory of vegetative cover and soil of upland areas of the State which was authorized by Chapter 1538, Stats. 1947. This survey has been conducted cooperatively by the Division of Forestry and the California Forest and Range Experiment Station. The Division of Forestry is responsible for general administrative supervision of the project, the selection of areas to be worked, preparation of budget requests, and over-all coordination. The California Forest and Range Experiment Station, by agreement, has general coordinating responsibility for the project operations.

The experiment station reports that the complexity of much of the wild lands of California and the increasing need for developing and managing more intensively these lands and their resources are the underlying reasons for conducting such surveys. Soil-vegetation survey information has important applications in: (1) timber cropland management, including possibilities for tree planting; (2) range management and forage production, including possibilities or relative ease for converting or improving brush land for range use; (3) watershed management and the control of water, particularly the determination of erosion hazards of soils; (4) planning road construction and maintenance; (5) locating field experimental research areas, or management trials, and reliably extending the results of such research and trials; (6) wildlife management and the appraisal of game ranges; (7) planning fire prevention, or the reduction of large fire hazards, and managing areas after fires; (8) planning recreation areas; (9) appraising land for bank or insurance loans, taxation equalization purposes, or exchange procedures; and (10) planning land managing units, and developing land management guides.

The first surveys under the cooperative arrangements ending June 30, 1952, approximately 3,000,000 acres were surveyed during this period, principally in Mendocino County with some adjoining land in Lake and Humboldt Counties. The project was reactivated in 1953 and an additional 1,813,000 acres surveyed as follows: Tehama County, 1,038,000 acres; Humboldt County, 445,000 acres; Glenn County, 200,000 acres; and Lake County, 130,000 acres. The current appropriation for this project is $92,741 annually. About 750,000 acres can be mapped during each field season at the present level of activity. It is presently contemplated that the soil-vegetation survey will continue at its present rate until some 25,000,000 acres of private range, brush, and forest lands are surveyed.

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Report of the

SENATE INTERIM COMMITTEE ON SALT WATER CONVERSION

(Senate Resolution No. 54, 1955)

SENATOR A. A. ERHART, *Chairman*

SENATOR JAMES E. BUSCH

SENATOR HUGH P. DONNELLY

SENATOR FRED S. FARR

SENATOR FRED H. KRAFT

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SENATE

CALIFORNIA LEGISLATURE

HAROLD J. POWERS
President of the Senate

HUGH M. BURNS
President pro Tempore

JOSEPH A. BEEK
Secretary

LETTER OF TRANSMITTAL

May 16, 1957

HONORABLE HAROLD J. POWERS, *President*
and Members of the Senate

GENTLEMEN: Your Senate Interim Committee on Salt Water Conversion created by Senate Resolution No. 54, 1955 Session, presents herewith its Progress Report for the Calendar Year 1956.

Respectfully submitted,

A. A. ERHART, *Chairman*
JAMES E. BUSCH
HUGH P. DONNELLY
FRED S. FARR
FRED H. KRAFT

FOREWORD

The research on the Salt Water Conversion Program is being done by the University of California, under the auspices of the Senate Interim Committee on Salt Water Conversion.

This program concerns methods of obtaining irrigation, industrial and domestic water from sea water and was started in 1952 with a special appropriation of $30,000 by the Legislature. Appropriations have been continued subsequently, and this study is continuing.

The following report is on the progress of research for the calendar year 1956.

A. A. ERHART, *Chairman*

SEA WATER CONVERSION PROGRAM

A TECHNICAL AND ECONOMIC INVESTIGATION OF CERTAIN SCHEMES FOR PRODUCING POTABLE FRESH WATER FROM SEA WATER

Progress Report for the Calendar Year 1956

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REPORT FOR THE YEAR 1956

SEA WATER CONVERSION PROJECT

UNIVERSITY OF CALIFORNIA

SUMMARY

The following notes attempt to summarize the developments in this field which have occurred during the calendar year of 1956.

Experimental Work

Various phases of the experimental work have been active at the University of California throughout the year.

a. Solar Distillation

The plant previously assembled was continued in operation. A wick-type still was installed, similar to one built at New York University, but much larger. Difficulties appeared in the larger size which did not occur in the smaller. These were not overcome until recently so that comparative performance data are yet to be obtained. Also, the use of paraffin as a medium for the collection and storage of solar heat at a controlled temperature was studied and an experimental unit is nearing completion.

b. Vacuum Flash Distillation using Low Temperature Differences (LTD System)

Experimental work on Plant No. 2 was stopped early in the year. By this time, runs had been completed at several different sets of conditions—with and without the turbine, at various over-all temperature differences, some with fresh water and some with bay water having about 70 percent of the salinity of sea water. These data showed rather conclusively that the amounts of water produced and power generated corresponded well with the thermodynamic calculations. Carryover of saline liquid drops limited the capacity of the evaporator. Consideration was given to control of this through the use of "drift eliminators" but tests of such equipment have not yet been run.

This equipment still appears to be one of the most attractive from the standpoint of large units and low costs. It is expected that work during this spring will give a basis for firm estimates.

c. Reversed Osmosis

Research at Los Angeles has continued throughout the year on the air-gap equipment. The emphasis continues to be placed on the production and maintenance of the .001" air gap between two sheets of cellophane. Problems of membrane support and of leakage are gradually being overcome.

The "pilot plant" reported as in the design stage last May is nearing completion at Los Angeles and should yield some test data before the end of the fiscal year.

Experiments at Berkeley have centered around the concept of the "ultra filter" capillary membrane. Techniques for making these filters and for testing them have been developed and the size of pore has been successfully decreased until it now approaches the size needed.

d. Ion Exchange

Work on the use of ion exchange materials regenerated by heat was begun at Berkeley early in the year. Attempts to use ammonium hydroxide as the exchange agent were unsuccessful as were also those made with ammonium carbonate. The chief problem was that of regeneration. Recently, a synthetic exchange material has been found which can be used with sea water and can be regenerated with ammonium bicarbonate. A small, two-stage mixed-bed plant is being assembled so that continuous operation may be possible.

Details of the experimental work are given in later sections of the report. While progress is not as rapid as could be desired, it should be evident that tangible advances have been made on a sound basis.

Analytical Work

a. Thermodynamic Analysis (Los Angeles)

During 1956, several chapters have been completed in an extensive treatise on the general treatment of the separation of brine and fresh water, as well as the treatment of specific methods of separation. These studies are important since the results indicate the directions in which to turn for improvements in potential efficiencies. The results are made available to the rest of the project personnel and will be generally published after further verification.

A fairly serious problem has been the lack of data on the thermodynamic properties of sea water. At present a graduate student at Los Angeles is undertaking the experimental determination of some of the needed data.

GENERAL ARRANGEMENTS

The program of research concerning methods for obtaining irrigation, industrial and domestic water supplies from sea water has been under way since January, 1952, when a special appropriation of $30,000 from the Legislature became available. Experimental work has been carried on both at Berkeley and at Los Angeles. Appropriations for the last two fiscal years have been divided between the two campuses as follows:

	Berkeley	*Los Angeles*
1955-56	$35,000	$25,000 *
1956-57	46,500	30,000

Work on the two campuses has been conducted independently, with coordination of the two programs by occasional visits and conferences between individuals and groups.

A State-wide Advisory Committee on Water Conversion was appointed by President Sproul in March, 1955, to assist in the coordination of the university's research program in this field. It consists of the following:

L. M. K. Boelter, Dean of the College of Engineering, Los Angeles;

F. A. Brooks, Professor of Agricultural Engineering, Davis;

M. R. Huberty, Chairman of the Department of Irrigation and Soils, Los Angeles;

Edward Teller, Professor of Physics, Berkeley;

C. D. Wheelock, Acting Director, Institute of Marine Resources, La Jolla;

E. D. Howe, Professor of Mechanical Engineering, Berkeley, Chairman of the Advisory Committee.

This committee has held two formal meetings. Occasional conferences of the chairman with individual members have served to supply guidance in certain aspects of the coordination activities.

RESEARCH PROGRAM

The investigations undertaken have been of two kinds, some of experimental nature and others analytical. Besides the main projects indicated in the following list, there have been many minor analytical investigations of suggestions received from inventors and others. Also, an attempt has been made to keep abreast of the progress elsewhere under the large federally sponsored program and thus avoid unnecessary duplication.

Most of the projects listed are still under investigation in one form or another as will be seen from the more detailed discussion which is contained in a later section of this report.

* This sum includes $15,000 from the U. C. Budget, plus $10,000 received from the United States Department of Interior for support of the air-gap osmosis (Hassler) project.

Methods Investigated on the Sea Water Conversion Project

I Distillation
- Multi-effect distillation using waste heat (Berkeley)
- Vacuum flash distillation using low temperature differences (Berkeley)
- Solar distillation (Berkeley)
  - Roof-type insulated stills
  - Tubular-type stills
  - Flat-type wick stills
  - Use of paraffin for heat storage

II Osmotic pressure application
- Air-gap membranes (Los Angeles)
- Capillary membranes (Berkeley)
- Skimming processes (Los Angeles)

III Separation by freezing
- Zarchin process (Berkeley)

IV Ion exchange
- Use of heat for regeneration (Berkeley)
- Use of clays for filtration (Los Angeles)

V General thermodynamic investigation (Los Angeles)

REPORTS AND PAPERS PUBLISHED DURING THE YEAR

1. Akobjanoff, L. and E. D. Howe. Vacuum Distillation of Water, Research (London) Vol. 9, No. 6, 1956, pp. 220-226.
2. Akobjanoff, L., Capillary Filters of Known and Adjustable Pore-Size. Nature (London) Vol. 178, November 10, 1956, pp. 1041-1043.
3. Howe, E. D., What New Sources of Water? Salt Water Conversion, Cloud Seeding. Address before California State Chamber of Commerce, November 30, 1956.
4. Howe, E. D., Experiments Underway to Obtain Demineralized Water for Cities. Western City, October, 1956, pp. 46-49.
5. Beorse, B. and J. W. McCutchan, Sea Water Demineralization Pilot Plant. Group Progress Report on the Reverse Osmosis System, October, 1956.
6. Tribus, M., R. Asimow, and N. A. Richardson, Energy Considerations in the Preparation of Fresh Water From the Sea. October, 1956. (Draft only—not available for distribution.)
7. Hassler, G. L., Research and Development of Molecular Oil Films for Use in the Large-scale Low-cost Demineralization of Saline Waters by a Pres-

sure Method. (Reports on Contract 14-01-001-67 with U. S. D. I.).

a. Tenth Progress Report—12/22/55 to 2/22/56—May, 1956.
b. Eleventh Progress Report—2/22/56 to 4/22/56—May, 1956.
c. Final Report—4/22/56 to 6/30/56—Sept., 1956.

COSTS OF WATER

The costs of water from natural precipitation sources are not easy to evaluate because of the diverse schemes used for capitalizing and operating water projects. However, it is generally conceded that demineralized sea water would find some application if it were producible at $40 per acre-foot for irrigation or at $125 per acre-foot for domestic supplies. Since these costs are much lower than any of the estimates for the conventional types of distillation, considerable attention has been given to unconventional types of demineralizing and to the ultimate possibilities of low costs.

The three important elements of cost for demineralizing processes are:

Fuel or power;
Capital investment;
Maintenance and operation.

When this investigation was begun, the costs of fuel or power alone for the distilling processes then in use were in excess of the $40 per acre-foot figure and for this reason attention was focused on schemes for using nonfuel sources of heat such as solar heat, waste heat from processing plants and heat from the ocean. More recently, it has appeared that certain processes may be expected to approach the ideal thermodynamic minimum fuel requirement of about 1300 kw-hours per acre-foot by a factor of two or three. Since the corresponding fuel cost would be considerably less than the $40 goal, the use of reversed osmosis and other processes has been studied.

The capital investment permissible in demineralizing plants should probably be in the same range as those for natural water developments, which appears to be from 50 cents to $4 per gallon per day of capacity. This should be regarded as a rough guide only, since the balance between the three cost elements will vary markedly from one process to another.

A major contribution to the cost information appeared during the year in the form of a standardized procedure for estimating costs, formulated and published by the Office of Saline Water of the U. S. Department of Interior. This should be of considerable aid in ascertaining the comparative status of the many schemes which have been proposed.

VACUUM FLASH DISTILLATION USING LOW TEMPERATURE DIFFERENCES (LTD System)

General

The low temperature difference method of distilling sea water is one in which the pre-existence of a small difference in temperature between two sources of water is utilized to accomplish both evaporation and condensation. This can be shown to be practical when the difference in temperature is 17 Fahrenheit degrees or more. It can also be shown that when temperature differences of 30 Fahrenheit degrees or more exist, power generation may also be included so that distilled water could be produced with no net power demand on external sources.

The general intent of this scheme for producing distilled water is to utilize nonfuel sources of heat, such as waste cooling water from chemical and other processing plants and solar-heated water, either from limited shallow ponds or from the ocean.

Vacuum flash distillation without fuel heat requires two sources of water at different temperatures. The warm water is passed through a nozzle into a vacuum chamber. The reduction in pressure causes the evaporation of a small part of the water, the heat being furnished by the cooling through a small range of temperature of the entire mass of water which flows through the nozzle. The steam formed by evaporation flows into a surface condenser which is cooled by the supply of cold water and is then liquified. Power is required to pump both the warm and cold water supplies through the plant as well as to remove the condensate and maintain the vacuum against air leakage from various sources. If the total initial temperature difference is as much as 30 Fahrenheit degrees the power needed for all pumping purposes can be supplied by a steam turbine wheel placed between the evaporator and condenser.

The program of experimental work began with the assembly of a very small plant using odds and ends of equipment which were available in the laboratory. Results of these tests were reported two years ago and were encouraging rather than conclusive. They showed that the estimated vapor production could be realized in the tank-type evaporator, but there remained the determination of the bases on which to make the formal design for prototype evaporators. Furthermore, questions had been raised as to the availability of energy in the expansion of steam at the very low pressures involved. To obtain answers to these two important questions, a larger plant was designed, constructed and tested.

Plant No. 2 was erected at the Engineering Field Station in Richmond and the tests on it made during 1955-56. The general arrangement of the plant is shown in the diagram of Figure 1 and the photo-

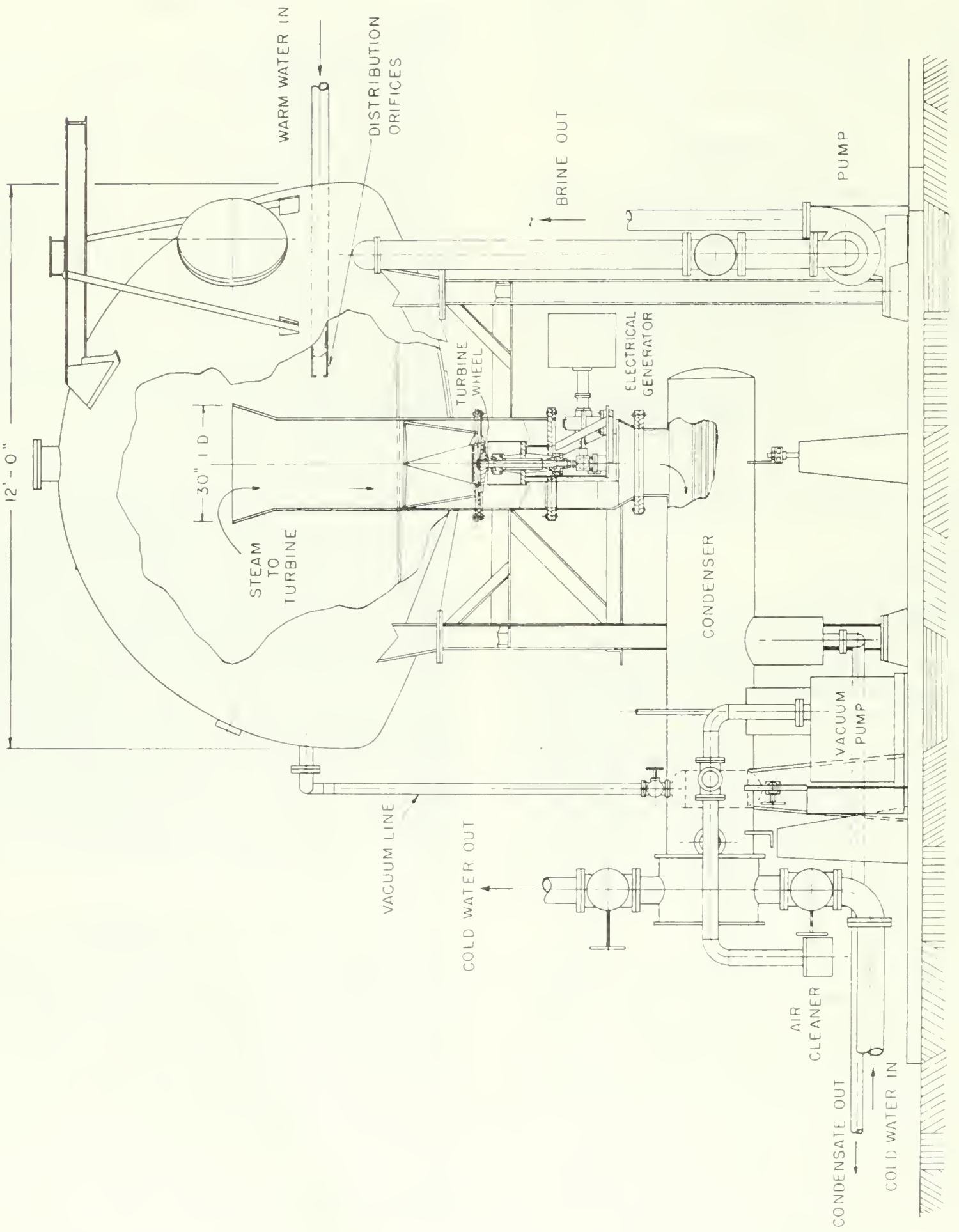

FIG. 1. LOW TEMPERATURE DIFFERENCE PLANT
(Schematic)

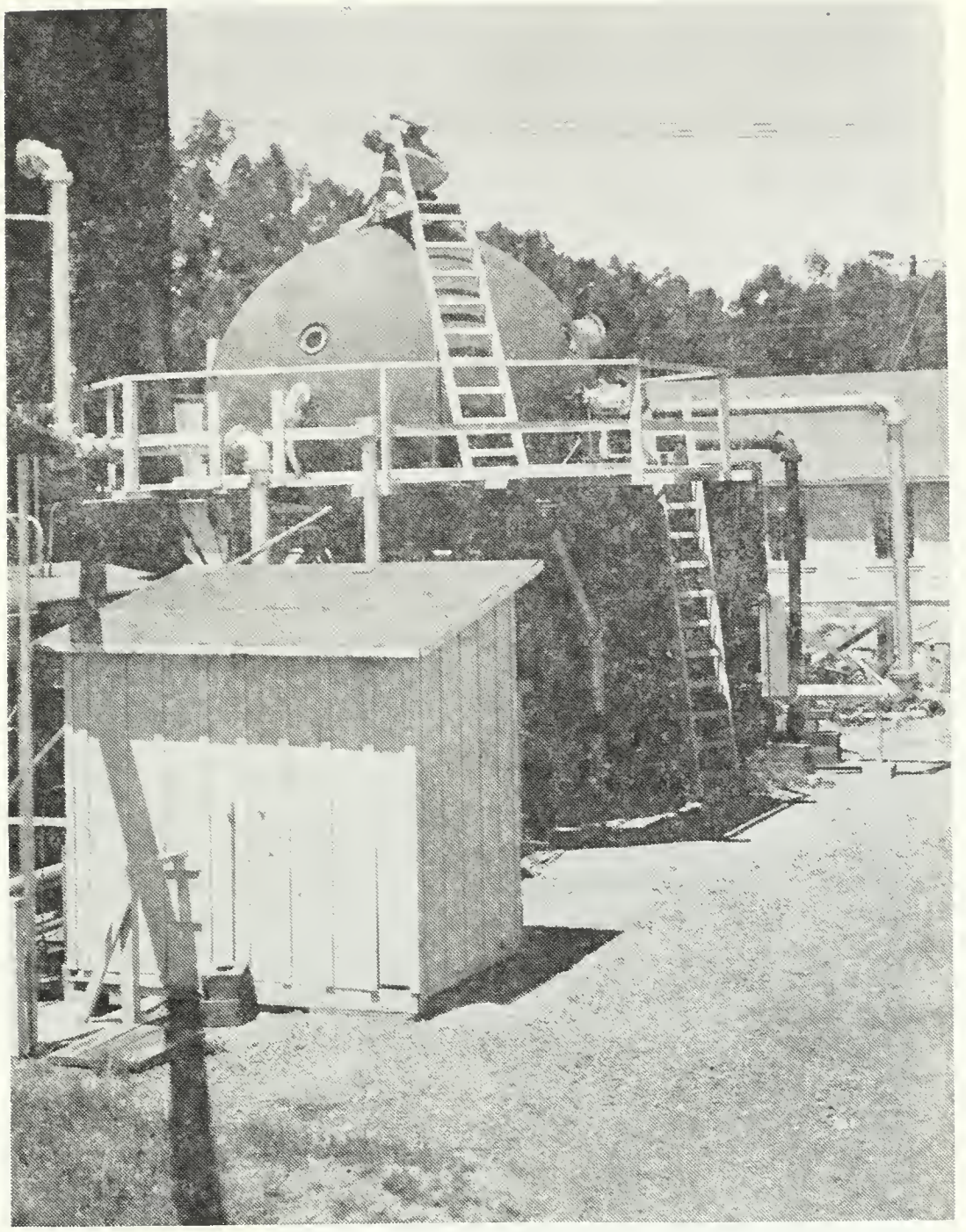

FIG. 2. L. T. D. PLANT No. 2—VACUUM FLASH DISTILLATION USING LOW TEMPERATURE DIFFERENCES

graphs of Figure 2. The plant was designed to utilize a small turbine wheel and its nozzle plate, which had been obtained from a war surplus supercharger.

Warm water was obtained by heating the water in the large tank with circulating gas-fired heaters. Cooled water was obtained by recirculation through a cooling tower. Many of the tests on this plant were run using tap water in order to minimize corrosion of the piping system and other elements which were not designed for corrosion resistance for economic reasons. These tests revealed the important characteristics and enabled the experimenters to program a relatively short series of tests using the highly corrosive water from the Bay.

The test results are given in tabular form in Table I. A technical report applying these data to the design of prototype plants is in preparation and will be issued soon.

SOLAR DISTILLATION

Solar distillation has now been under investigation continuously since February, 1952, when the first distiller unit went into service. The plant now consists of the following units:

1 Glass-covered, mirror-backed insulated still—4′ x 8′.
5 Glass-covered, symmetrical type insulated stills, each 4′ x 50′.
1 Plastic-covered tubular type still—4″ x 50′.
1 Wick-type still—4′ x 8′.
1 Paraffin-packed insulated solar heat absorber—4′ x 8′.

TABLE I

PERFORMANCE DATA ON 12′ DIAMETER LTD PLANT
Plant No. 2

Run No.	Date	Warm water		Cooling water		Ave. flow rate (g.p.m.)		Ave. pressure in evap. (in hg.)	Ave. turbine speed (r.p.m.)	Ave. turbine power (H.P.)	Ave. yield (test) flow rate (g.p.m.)
		Out ° F.	In ° F.	In ° F.	Out ° F.	Hot water	Cold water				
2	2/28/55	74.	80.	59.	62.	230	370	.72	--	--	2.1
4	7/13/55	99.	101.	80.	86.	385	375	1.43	--	--	2.7
5	7/15/55	89.8	102.4	79.	85.1	200	380	1.33	--	--	2.58
6	7/21/55	86.3	95.1	73.4	80.4	326	378	1.29	--	--	2.28
7	7/23/55	82.2	86.9	72.3	75.9	320	381	1.11	--	--	1.41
9	8/ 6/55	85.7	88.8	69.0	73.3	444	400	1.26	--	--	1.86
13	10/ 7/55	85.9	90.4	73.0	76.51	248	380	1.78	--	--	1.49
14	10/11/55	83.57	89.9	70.9	74.8	248	361	1.90	--	--	1.49
16	11/ 1/55	87.	90.	54.	57.	342	275	1.27	3,000	1.2	1.17
17	11/ 3/55	92.	94.4	55.8	59.8	390	278	1.46	3,700	1.8	1.55
18	11/ 4/55	99.7	104.2	68.6	72.6	389	380	1.90	5,000	3.8	2.00
19	11/ 9/55	94.6	96.3	71.1	74.0	323	288	1.62	4,500	3.0	1.25
20	11/10/55	91.	96.0	65.0	68.	363	380	1.43	2,600	.8	1.35
21	11/11/55	96.	99.5	59.	61.	363	376	1.63	5,500	3.4	1.73
22	11/15/55	93.	96.5	47.	48.	390	362	1.58	6,500	4.5	1.94
24	11/30/55	85.	90.	74.5	77.5	360	370	1.22	--	--	1.68
26	12/ 6/55	78.5	82.2	58.	61.2	583	366	1.00	--	--	1.40
27	12/ 7/55	80.	83.	59.	63.	573	368	1.04	--	--	1.24
28	12/12/55	74.	75.	59.	60.5	450	367	.88	--	--	.54
29	12/13/55	85.5	88.5	71.	76.	470	275	1.24	--	--	2.93

The entire plant is shown in the photograph, Figure 3.

The performance characteristics of the first three types listed above have been previously reported and are indicated by the performance curves in Figures 4 and 5. Figure 4 shows the performance of the small mirror-backed still in terms of its production rate versus the solar intensity. From this curve it will be noted that efficiency of solar heat utilization decreases from about 55 percent at 1,000 $\frac{\text{Btu.}}{\text{ft.}^2 \times \text{da.}}$ to about 48 percent at 25,000 $\frac{\text{Btu.}}{\text{ft.}^2 \times \text{da.}}$. This is consistent with the fact that the heat losses increase as the temperature of operation increases, and of course, the temperature of operation increases with the solar intensity.

Figure 5 indicates in a general way why the points in Figure 4 are scattered, particularly at solar intensities of 1,700 $\frac{\text{Btu.}}{\text{ft.}^2 \times \text{da.}}$ and above. This figure applies specifically to the 4′ x 50′ stills but also applies in a general way to all hood-type stills. For high solar intensities it is clear that the presence of wind greatly increases the production rates. Also, it will be evident from the curves that the wind conditions at the test site seem to be related to the solar intensity, since there are no points at high solar intensity and low wind velocity.

The results of the above tests indicated rather definitely that solar stills of the simple type could be expected to utilize about 50 percent of the solar energy incident on a horizontal surface. In terms of conditions in California this amounts to about 3.4 acre-feet per year per acre of tray collector surface. The cost of the tray-type equipment used up to this time is $2 per square foot or nearly $28 per gallon per day. This is regarded as much too high.

The wick-type still tested is shown in the photograph of Figure 6. It consists of a flat box with the two large sides made of glass, with a centrally located glass-cloth wick between. This unit is patterned after a small one constructed at New York University by Dr. Maria Telkes as part of the U. S. Department of Interior research program.

The U. C. model used glass cloth rather than toweling because the water from San Francisco Bay caused toweling to fail when first tried. Glass sailcloth was then used and found to be quite strong and durable. It was blackened to improve solar heat absorption by the precipitation of carbon black on the surface.

The purpose of the wick is to present a wetted surface perpendicular to the sun's rays at noon and therefore subjected to an intensity of radiation higher than possible on a horizontal surface. A further advantage lies in the very small heat capacity of the wick, as compared with the tray and its insulation in the other units tested. Experimental difficulties not completely solved in the U. C. model included the problem of stretching the cloth wick uniformly throughout its eight-foot length and keeping the wick surface uniformly wet at reasonable rates of water feed to the wick. It is clear that high flow rates of water down the surface of the wick will result in much of the heat being carried out of the enclosure with the waste brine. The difficulties with these problems were so severe that the data collected are not regarded as representative of optimum performance. Recent improvements to the unit should make possible some satisfactory data during the spring.

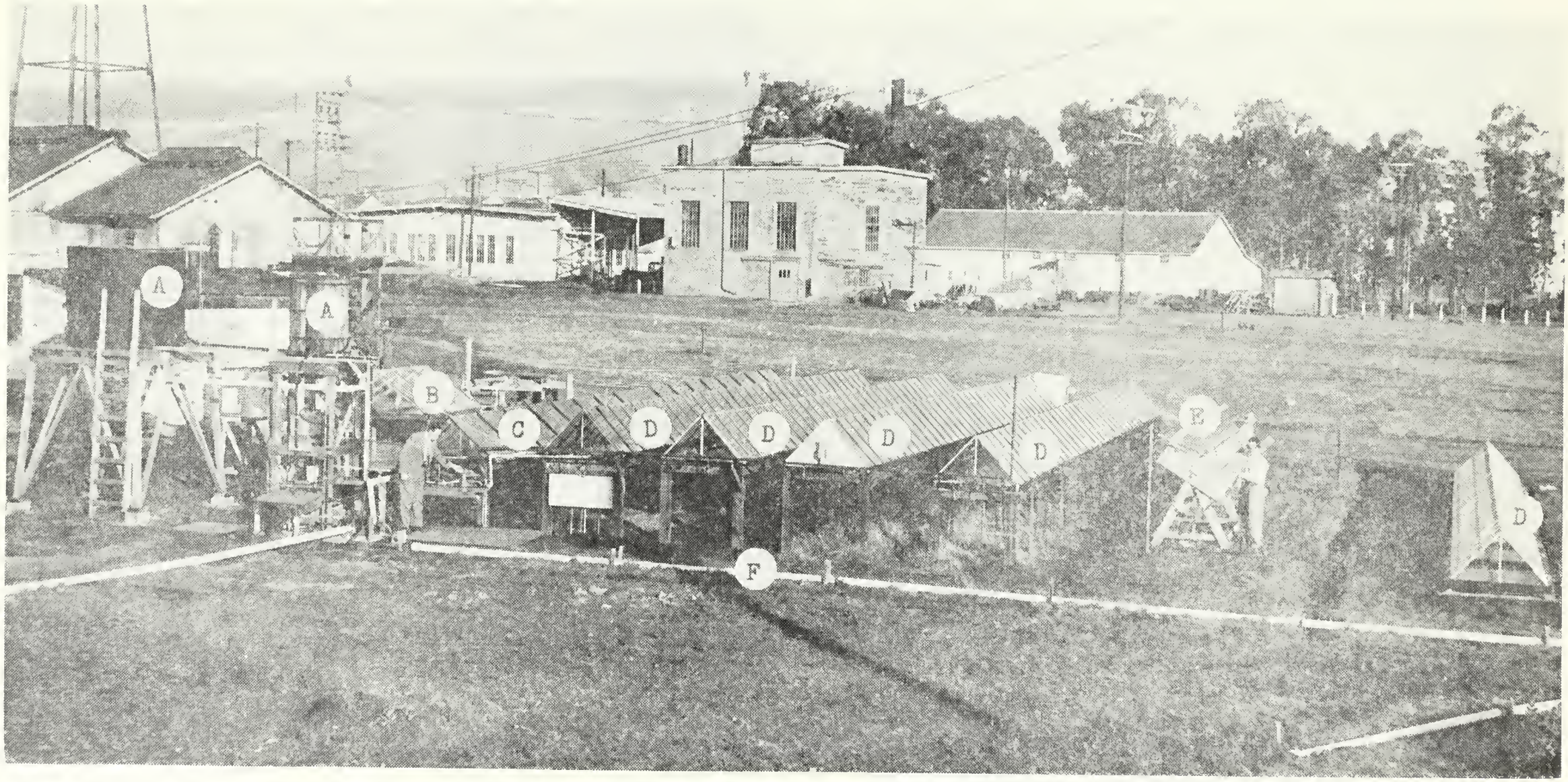

FIG. 3. GENERAL VIEW OF SOLAR DISTILLATION EQUIPMENT AT ENGINEERING FIELD STATION, RICHMOND

A. Water tanks
B. Small glass-covered still with mirror back
C. Plastic-covered still
D. Five glass-covered units as in Figure 5
E. Parabolic mirror for water heating
F. Waterline from San Francisco Bay

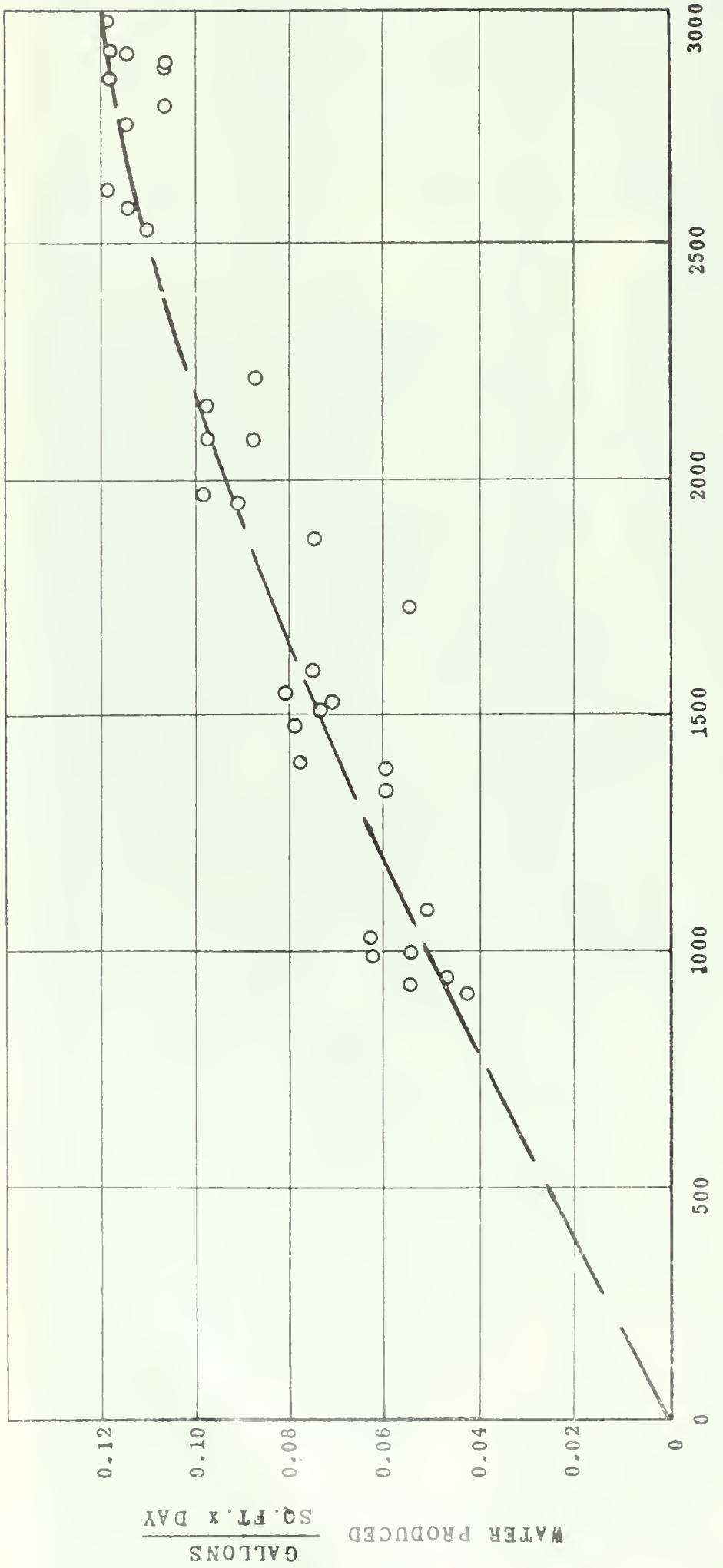

FIG. 4. PERFORMANCE OF 4′ × 8′ SOLAR STILL

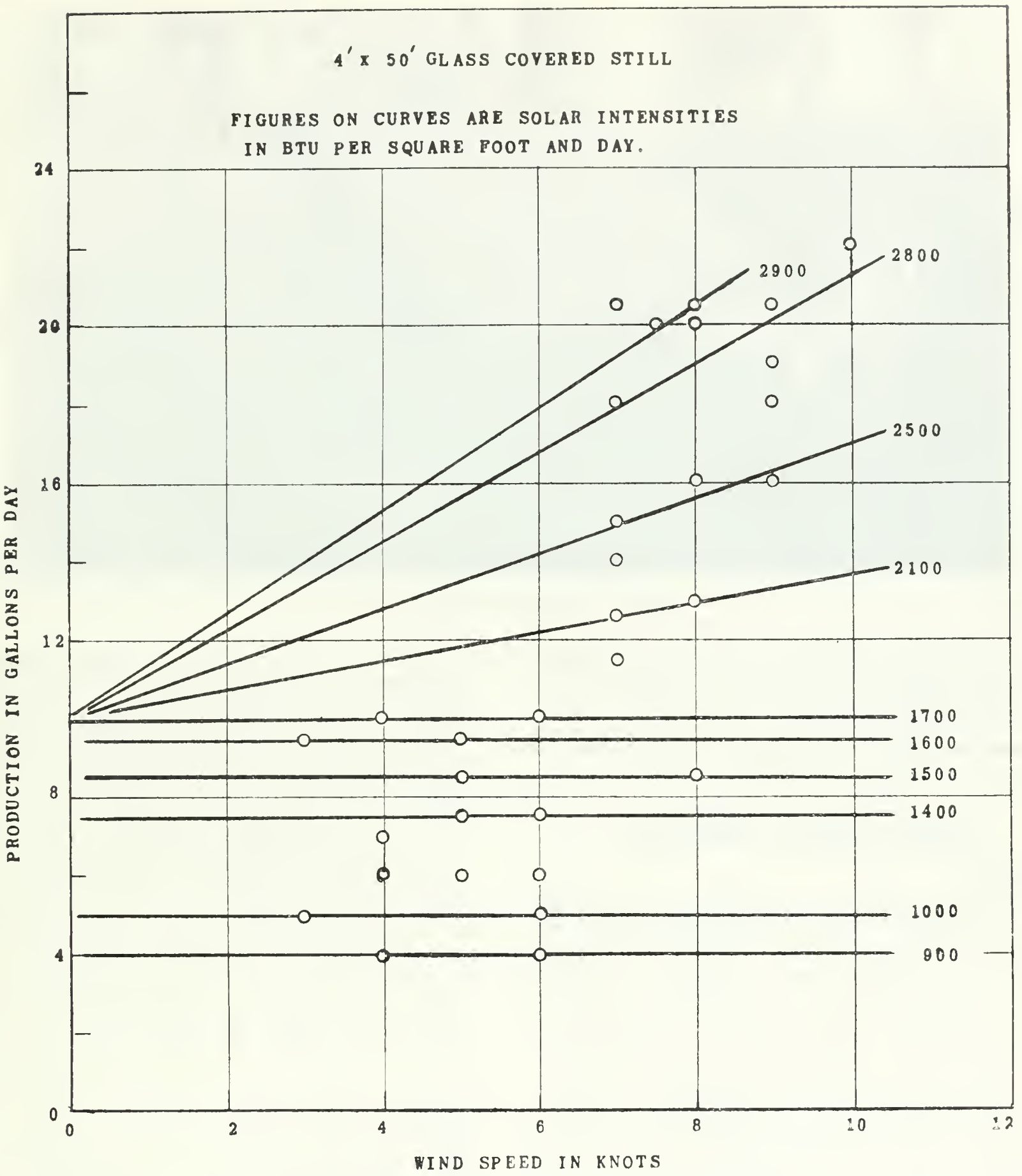

FIG. 5. EFFECT OF WIND ON PERFORMANCE OF SOLAR STILL

Summary

Solar distillation has so far proven to be too expensive because of the high cost of equipment per unit of daily capacity. This cost could be reduced by:

a. Cheaper construction, retaining the tray or wick form with transparent covers.

b. Finding some scheme for re-using the heat even at these low temperatures. (Note that the work with paraffin just begun is in this direction.)

c. Evolving or developing a means for collecting the heat without the use of the expensive glass-covered tray construction. Possibilities includes the use of shallow ponds, gently-sloping surfaces,

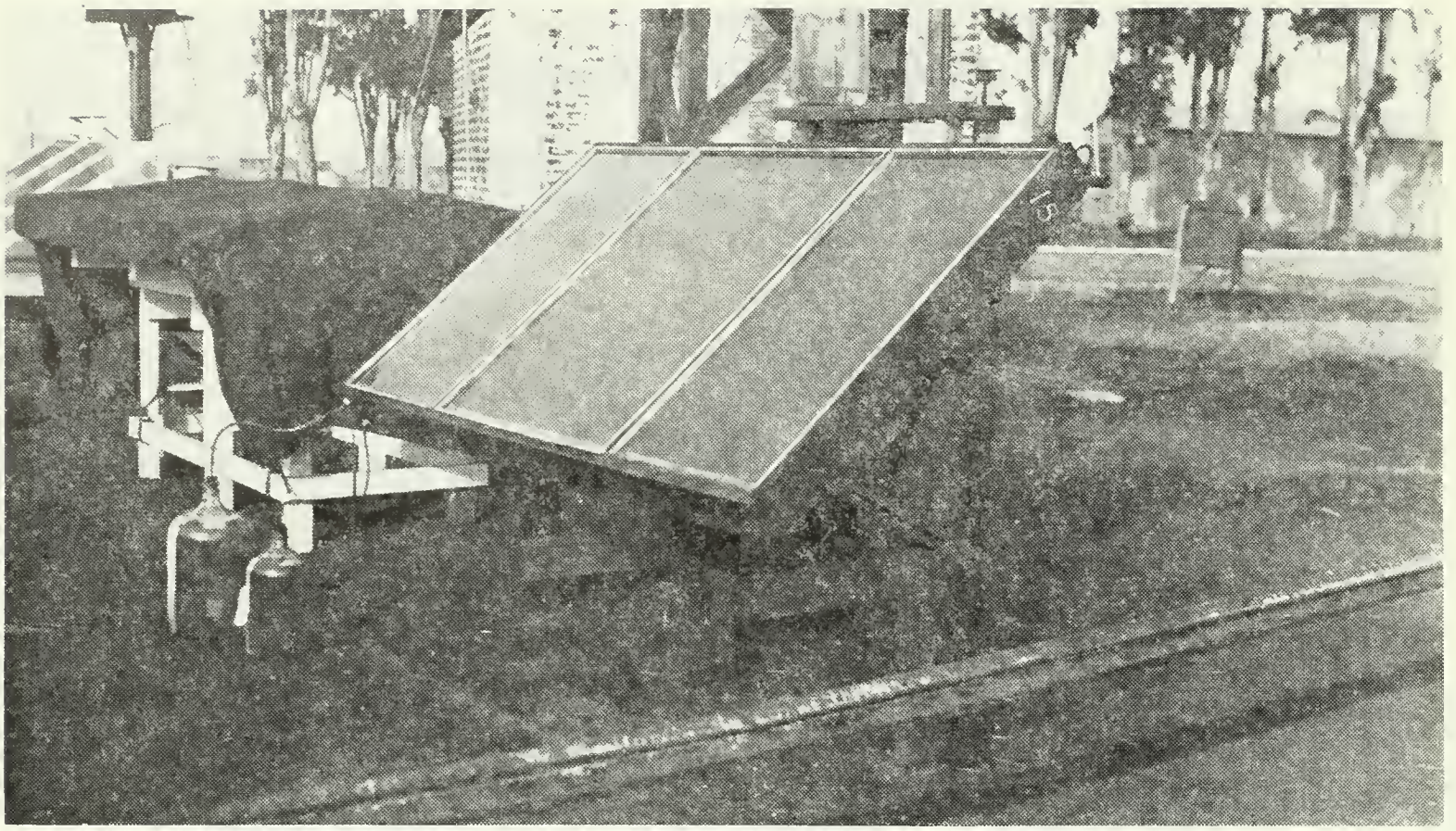

FIG. 6. WICK-TYPE SOLAR STILL 4′ x 8′

and periodic flooding of marsh lands, together with condenser units passing very large quantities of air.

Before bringing to a close the work on solar distillation, it is planned to give attention to the above.

REVERSED OSMOSIS SEPARATION

General

It has been observed that some membranes are "semipermeable" or that when used as a boundary between two aqueous solutions of different concentrations, such "semipermeable" membranes will pass water more readily in one direction than in the other. Experimentally, it is found that the net migration of water through the membrane is always in a direction such as to tend to equalize the concentrations, i.e., from the weaker solution into the stronger one. Further, it is observed that this flow will continue against pressures of considerable magnitude. For example, the pressure required to stop the flow of pure water through a semipermeable membrane into sea water is about 25 atmospheres. By imposing pressures in excess of 25 atmospheres on the sea water in the opposite direction it should be possible to reverse the direction of flow and cause the flow of pure water out of sea water, through a semipermeable membrane and into a reservoir of fresh water.

While the above material refers to the "flow" of water through the membrane the precise mechanism is uncertain. In some instances it is likely that the phenomenon has occurred without phase change while in others it is evident that there has been a flow of vapor by diffusion, necessarily preceded by evaporation from one body of liquid and followed by condensation into the second body of liquid. While this difference may seem unimportant, it is the source of the two different approaches being used in the project.

With the assumption that no phase change occurs, the problem of using reversed osmosis for water purification becomes essentially a mechanical "filtration." The pores in the membrane must be sufficiently small to block the passage of the dissolved salt ions and yet large enough to allow water molecules to pass through. While exact measurements of the effective dimensions of ions such as sodium and chloride have not been made, it is generally conceded that these ions are much larger than are the water molecules and that they could not pass through holes of the order of five Angstrom units in width (5 times 10^{-7} millimeters).

Three investigations related to reversed osmosis are being carried on in the University of California. The Los Angeles investigations under Dr. Gerald Hassler is an attempt to utilize the phase change concept noted above by providing an air-gap or oil-gap of about .001″ width across which the water will move as vapor. The narrow width is necessary for achieving low power consumption. A second Los Angeles investigation, under Professor Yuster, attempts to utilize the no-phase-change concept noted above, except that the pores are assumed to occur in some

parent material which is electrically charged in such a manner as to repel any ions (also electrically charged) which may tend to enter the pores. Under this assumption the pores could be appreciably larger than the ions. A project at Berkeley, under Dr. Akobjanoff, also attempts to use the no-phase-change concept. However, this project is based on the assumption that a size difference exists between the water molecules and the dissolved ions and that a membrane with very small uniform pores could be used for a purely mechanical filtration.

The experimental difficulties present in all three projects will be realized when it is appreciated that the separatory membranes must be strong enough to withstand at least 400 pounds per square inch of pressure, either through their inherent strength or through some form of support.

Air-gap and Oil-gap Equipments

Experiments at U. C. L. A. have been carried on for several years in the attempt to use thin layers of air or oil as osmotic membranes. These tests have been financed by the U. S. D. I. Saline Water Conversion Program until June 30, 1956, after which date they have been financed by the funds appropriated through the university budget. In these equipments cellophane sheets are used as boundaries for the air gap, the separation of the cellophane sheets being accomplished by either the coating of one sheet with a uniformly sized nonwettable powder or the printing of a grid pattern on one of the sheets. The thickness of the air gap is then determined by the size of the powder grains or the thickness of the ink pattern, and is designed to be of the order of about .001″.

The strength required to support the air gap under the osmotic pressure is furnished by laying the cellophane "sandwich" on a metal or ceramic porous plate. Sea water osmotic pressure is then exerted on the cellophane sheet farthest from the supporting plate. Air pressure of about the same magnitude is maintained in the air gap to support the cellophane between grains of powder or between the lines of printing and to prevent the flow of liquid water across the gap.

The physical operation of this osmotic device has been described as a sort of "pressure" distillation. It is supposed that the pressure on the sea water causes it to fill the very small pores in the cellophane and to bulge into the air gap with lens-shaped surfaces maintained by the surface tension. On the other cellophane sheet the fresh water is under a much smaller pressure, so that the curvature of the water surfaces in the pores is much different than in the case of the salt water. The vapor pressure in equilibrium with any water surface increases with the pressure. Thus, the vapor pressure on the sea water side is greater than that on the fresh water side of the gap so that vapor tends to migrate across the gap and condense on the fresh water side. Of course this process of evaporation and condensation is accompanied by the transmission of the latent heat across the gap. This latter is explainable in terms of conduction with very small temperature differences (about 0.1° F.) across the air gap.

It is proposed that the pairs of cellophane sheets be "stacked" so that alternate layers of water will be salt and fresh. This would make for simple and cheap construction and would place many layers of sea water in parallel so that they could be furnished with pressure through a manifolding connection. While the discussion has specified "air-gaps," exactly the same arguments could be used with an oil gap.

Experimental work up to the present time has had as its major objective the solving of the mechanical problems relating to the production and maintenance of the air gap between two cellophane sheets. Various means of separating the sheets have been used, including the use of nonwetting powders, a coating of carbon baked onto the sheet, several patterns and kinds of printing.

The first unit of this type was built in 1954 and used an air gap between two solid porous surfaces. This unit served to demonstrate the fact that the net effect was the transmission of pure water across the gap. Since that date considerable work has been done on the utilization of cellophane membranes. The mechanical problems of maintaining the narrow gap, of sealing the edges and of controlling the several flows have been very difficult to solve. The results have been encouraging but not conclusive. The latest design of test unit is shown in Figure 7.

Another phase of the investigation has been concerned with the possible use of *negative* pressures of the order of 30 atmospheres on the fresh water side. This is the phenomenon used in the Berthelot Tube. This tube is a small sealed glass tube completely filled with water except for a vapor bubble. By attaching strain gages to the glass it is possible to estimate the internal pressure as this tube, and the water in it, are heated and cooled. Under certain conditions, it is possible to make the bubble disappear and to produce a continuous column of water along the tube even though the strain gages indicate negative pressures in the water of over 30 atmospheres. If the product water in the osmotic apparatus can be made to sustain this very high "cohesive tension" without vaporizing it should be possible to avoid some of the mechanical problems related to the use of the high osmotic pressures.

So far, cost estimates are only rudimentary, but it is pointed out that the osmotic membranes are themselves made of very cheap materials and the power requirement is much less than needed for the vapor compression process. Thus, if the several problems of

design can be solved, a low-cost method of producing water may be achieved.

A third phase of the air-gap investigation is the study of the diffusion osmosis phenomenon using a single membrane. The air-gap is wider than in the "sandwich" arrangement already described and is bounded on one side by a porous plate of solid material and on the other side by a sheet of cellophane. The apparatus is shown in Figure 8. The purpose of this study is to evaluate the effectiveness of the air-gap principle. Equipment is in the process of assembly under the direction of Professor McCatchan and should be operating shortly.

Capillary Membranes

The program at Berkeley has been directed toward the construction of membranes with high mechanical strength. The general idea has been to use bundles of parallel fibers with flow through the capillary spaces between the fibers. The fiber bundles are held in some clamping device, such as tight-fitting hole in a plastic sheet, and have been made with effective clamped lengths from about ⅛" to over ½".

The first part of the investigation was devoted to determining whether or not any natural fibers could be found with satisfactory characteristics. The materials investigated included the following:

Asbestos	Nylon
Cardboard	Paper
Ceramic Candles (unglazed)	Rayon
Cotton	Silk
Feathers	Sisal
Glass	Straw
Jute	Wood
Leather	Wool
Linen	

The scheme used for testing the effectiveness of these fibers was to form a filter unit in a short piece of ¼" diameter "Tygon" tubing with an adjustable metal clamp restricting the space between the fibers. This filter unit was then used as the inlet to a siphon tube connected to drain the liquid from an elevated container. The liquid used was distilled water into which had been dissolved some sodium chloride, dextrose and methylene blue. Presence of these materials in the filtrate was readily determinable. The results of these tests were negative so that attention was then turned to synthetic fibers such as Dacron, fiberglass, nylon, Orlon and rayon.

Samples of various diameters of the several fibers were solicited from manufacturers and comparative flow tests set up. Various techniques were devised for preparing the filter units. Each change was in the direction of making the bundles tighter and maintaining the parallelism of the many fibers. Measurement of flow rates through the bundles and microscopic examination of sliced sections shows considerable progress toward the realization of the five Angstrom pore size desired. Operation of certain of the filter units in aqueous solutions shows a decrease in flow rate with time, due apparently to absorption of water by the fibers and their consequent swelling. To check these results, a long-term series of tests of filter units in siphons was set up and is shown in Figure 9. Results of these tests and other information are included in a technical report to be issued in the next few months.

ION EXCHANGE

Ion exchange is a method of water demineralizing in which the unwanted salt ions are "plated out" of solution in exchange for other ions. This process is accomplished by causing the water to trickle through a bed of the exchange material, similar in appearance to a sand filter. The materials ordinarily used would cause to pass into solution, hydrogen ions in exchange for positive metallic ions such as sodium or magnesium and hydroxide ions in exchange for the negative ions such as chlorine and sulfate. When enough water has passed through the bed, the hydrogen and hydroxide ions become exhausted and the bed must be regenerated. This is accomplished by passing a solution containing an acid and then one containing a base, through the bed. These solutions cause the ions previously plated out to again dissolve and "exchange" places with the hydrogen and hydroxide ions. The resulting brines are wasted and the flow of the product water is then resumed.

The cost of acid and alkali materials to accomplish the regeneration described above is over $1,000 per acre-foot so that some scheme must be found in which the chemicals can be re-used. Gilliland suggested the use of ammonium carbonate or bicarbonate as an exchange material and others have suggested ammonium hydroxide. The general idea would be that the ammonium ion would pass into solution in exchange for the positive metallic ions and the carbonate ion would exchange with the negative ions. The product water would then leave the exchanger bed charged with ammonium carbonate. Heating of this solution would drive off the dissolved material as a mixture of ammonia and carbon dioxide gases. These could be captured and redissolved to serve as the regenerant material.

Work on this project during the past year has consisted of a detailed cost estimate as well as some experimental work on the selection of a conventional exchange material and the conversion of this to the special ammoniated type mentioned above.

The detailed cost estimate was made on the assumption that the technical chemical problems could be

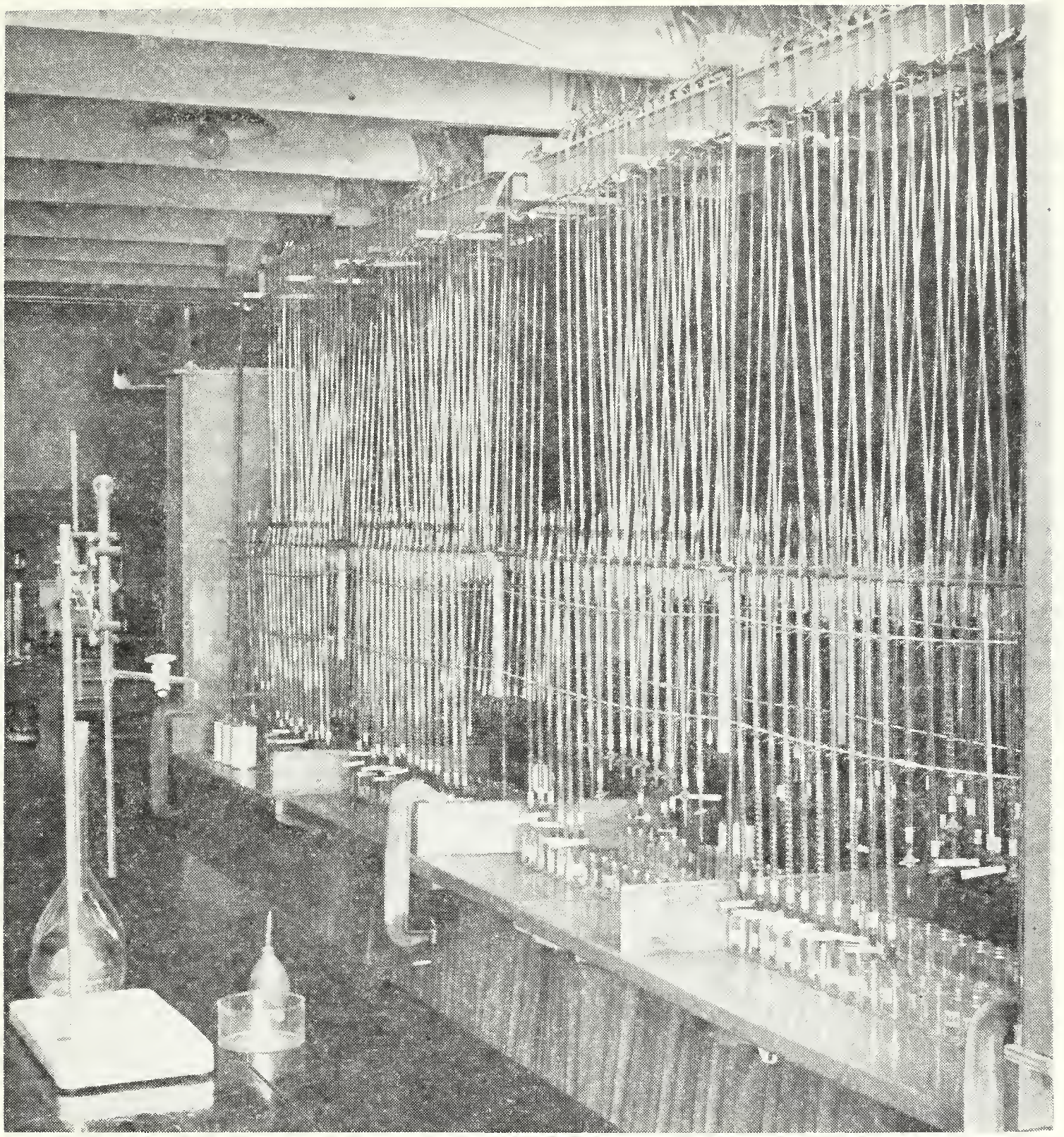

FIG. 9. CAPILLARY MEMBRANE TEST

NOTE: Capillary membrane units are connected to siphon water from tank at top of picture to graduated burettes near bottom.

solved, and that the removal of the ammonium bicarbonate would be accomplished by a vapor compression process. Estimates were made for plants producing at rates of 100,000 g.p.d., 1,000,000 g.p.d. and 10,000,000 g.p.d. Total costs amounted to, respectively, $2.04 per thousand gallons, $0.96 and $0.49. These estimates are very conservative.

Experimental work has involved the testing of a number of exchange resins, first for collection of the ions from the sea water and second, for regeneration by the use of ammonium hydroxide, carbonate and bicarbonate. Thus far, no resins have been found which could be regenerated satisfactorily with hydroxide or carbonate. Recently it was found that a pair of the commercial resins could be regenerated with ammonium bicarbonate. Further tests with these resin have shown that they can be used in a mixed-bed arrangement, but that two stages with degassing units between, must be used if the product water is to be sufficiently low in salt ions to be potable. Present efforts are directed toward the construction of a small pilot plant to determine the requirements of heat,

power and make-up chemicals for a continuously operating plant.

THERMODYNAMIC ANALYSIS

Thermodynamics deals with the general relationships between heat energy, chemical energy and the various forms of mechanical energy. It is possible to set up a generalized model of a demineralizing system for which are specified only the conditions of the streams of water entering and leaving the system. From these conditions it is possible to compute the energy required by an ideal system to perform the separation of the fresh water from the brine. There is general agreement on the results of this type of analysis between the report being prepared at U. C. L. A. and those published by Gilliland and by Murphy, namely that the separation of a stream of sea water into two streams, one of brine and the other of fresh water, requires about 3 kw-hours per thousand gallons when the flow rate of fresh water is much less than that of brine. If a minimum pumping energy requirement is introduced it is shown that at least 4 kw-hours per thousand gallons is required. These figures are based on computations assuming sea water to be a solution of sodium chloride alone. As already noted, this assumption is a first approximation only and can be improved by measuring the thermodynamic properties of actual sea water with its many dissolved minerals in addition to the sodium chloride. Such measurements are to be undertaken at U. C. L. A.

A unique contribution being made by Professor Tribus and his associates at Los Angeles relates to the consideration of specific processes rather than the completely generalized process referred to in the previous paragraph.

As indicated above, the very general analysis relates to a "black box" which contains an unknown but ideal system which operates reversibly. If one turns to real systems and studies the irreversibilities introduced by practical considerations it is possible to determine from thermodynamical arguments which of the irreversibilities have the most effect on the power or heat requirements and consequently which should be given the most attention experimentally. Preliminary studies of several of the well-known demineralizing processes have been completed with results that are in some disagreement with the general trend of developments in those processes. These conclusions are preliminary and must be very carefully checked and verified before being published in a technical report from the project.

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